Assessment

Forest Plan Revision

Draft Renewable and Nonrenewable Energy and Mineral Resources Report

Prepared by:
M. Patrick Pierson
Custer Gallatin Forest Geologist

for:
Custer Gallatin National Forest

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Introduction

This forest plan assessment report is intended to serve as a brief, but focused description of renewable and nonrenewable energy, mineral resources, and conditions found across the Custer Gallatin National Forest. Topics discussed address items required by the 2012 Planning Rule (36 CFR Part 219), and also those considered important to the future management of all geologic resources and issues over the life of the ensuing forest plan. The diversity of topics included is reflective of the geologic and geographic diversity represented across the 400 miles of the Custer Gallatin National Forest.

An overview of forest geology is included since rock composition directly influences the presence or absence of mineral and energy resources and capabilities. A brief description of the underlying geologic condition is included in recognition of its influence and control on the inherent ability of the land to provide and support a variety of management actions. A variety of Federal mineral, energy, and geology resource policy and regulatory frameworks are briefly described because they directly influence the development of mineral and energy resources or the management of geologic resources within the planning area. The land status of an area, in conjunction with applicable laws and regulations, directs the management of mineral and energy resource activities. Consequently, land status classifications pertinent to the planning area are further discussed below under the section entitled “Land Status and Mineral Resources.”

Process and Methods

This assessment of the geology, renewable, and nonrenewable mineral and energy resources of the Custer Gallatin National Forest is based on best available scientific information from numerous resources. These include Federal statutes, laws, and regulations, Forest Service manuals, State of Montana Department of Environmental Quality data, Custer Gallatin project and permit files, Montana Bureau of Mines and Geology publications and data, Montana Department of Natural Resources and Conservation information, State of South Dakota Department of Environmental and Natural Resources data, South Dakota Geological Survey, Bureau of Land Management (BLM) minerals forecasts, U.S. Geological Survey published documents and maps, U.S. Bureau of Mines published documents, Environmental Protection Agency (EPA) website and published documents, U.S. Energy Information Administration and U.S. Department of Energy (Oak Ridge National Laboratory) data, and other academic and professional peer-reviewed literature. Specific sources of information used in this assessment can be found listed in the “References” section of this report.

Scale

This renewable and nonrenewable energy and mineral resources assessment was conducted at a multitude of scales, and includes the physiographic province scale (Middle Rocky Mountain and Great Plains), the defined landscape area scale, and the ranger district or portions of ranger district scale (land unit). Geologic processes that have contributed to the existing condition of the Custer Gallatin National Forest function on a larger regional basis, while mineral occurrences, geologic hazards or geologic interest areas, as examples, are best described at the landscape area scale.

Existing Information Sources

Regulatory and Management Framework

The authority to manage and regulate the exploration and development of mineral and energy resources within National Forest System lands is jointly shared between the Secretary of Agriculture and the Secretary of the Interior. The administration of the mining laws and the mineral leasing acts is primarily the responsibility of the Department of the Interior, BLM. Certain mineral leasing acts require the consent of the Secretary of Agriculture and are subject to such conditions prescribed to ensure the adequate utilization of the lands for the purposes for which they were acquired or are being administered.

The Forest Service has entered into interagency agreements with Interior Department agencies to cooperate and coordinate in managing federally owned minerals within National Forest System lands (FSM 2801.3). The Forest Service is responsible for managing the occupancy and use of the surface by persons conducting these activities and to manage the disposal of certain mineral materials. The primary laws for minerals management on Federal lands include the following.

- General Mining Law of 1872. This act authorizes placer and lode mining claims, mill sites and tunnel sites of specific dimensions and a patenting process. This act sets forth the principles of discovery, right of possession, assessment work, and patent for hardrock minerals on lands reserved from the public domain. The law applies to lode, placer, millsite claims, and tunnel sites. Except as otherwise provided, all valuable mineral deposits, and the lands in which they are found, are free and open to exploration, occupation, and purchase under regulations prescribed by law (FSM 2810).
- Organic Administration Act of June 4, 1897 (30 Stat. 11, as amended; 16 U.S.C. 473-475, 477-482, 551). This act provides the Secretary of Agriculture the authority to regulate the occupancy and use of National Forest System lands. It provides for the continuing right to conduct mining activities under the general mining laws if the rules and regulations covering National Forest System lands are complied with. This act recognizes the rights of miners and prospectors to access National Forest System lands for all proper and lawful purposes; including prospecting, locating, and developing mineral resources.
- Mineral Leasing Act of 1920 as amended. This act provided that deposits of laterally extensive minerals such as coal, oil, gas, and phosphate could be acquired through competitive leasing systems.
- The Materials Act of 1947. This act provides for the disposal of mineral materials on the public lands through bidding, negotiated contracts, and free use.
- Mining Act of July 23, 1955 (69 Stat. 368; 30 U.S.C. 601 et seq.). This act requires the disposal of common varieties of sand, stone, gravel, pumice, pumicite, and cinders under the provisions of the Materials Act of July 31, 1947, and gives to the Secretary of Agriculture the authority to dispose of these materials. It also provides that rights under any mining claim located under the mining laws are subject to the right of the United States to manage and dispose of surface resources.
- Multiple Use Mining Act of 1955 (30 U.S.C.611-615). This act authorizes the Forest Service to restrict mining operations on National Forest System lands to only those uses reasonably incident to mining and in a manner that minimizes adverse environmental impacts.
- Mining and Minerals Policy Act of December 31, 1970 (84 Stat. 1876; 30 U.S.C. 21a). This act states that the continuing policy of the Federal Government is to foster and encourage private enterprise in the development of economically sound and stable domestic mining and minerals industries and the orderly and economic development of domestic mineral resources. This act provides for the study and development of methods for the disposal, control, and reclamation of

mineral waste products and the reclamation of mined lands. This requires an evaluation of geology as it relates to ground water protection and geologic stability.

- Title 36, Code of Federal Regulations, Part 228. These regulations set forth rules and procedures governing use of the surface of National Forest System lands in conjunction with operations authorized by the general mining laws, and mineral material disposal laws.
- The Geothermal Steam Act of 1970, as amended, established a competitive and noncompetitive system for leasing geothermal resources and associated by products.
- Resource Conservation and Recovery Act of 1976 (RCRA) (90 Stat. 2795; 42 U.S.C. 6901) as Amended by 92 Stat. 3081. This act, commonly referred to as the Solid Waste Disposal Act, requires protection of ground water quality and is integrated with the Safe Drinking Water Act of December 16, 1974, and Amendments of 1977 (42 U.S.C. 300(f)). (FSM 7420.1.)
- Federal Coal Leasing Amendments Act of August 4, 1976, (90 Stat. 1083; 30 U.S.C. 201 et seq.). This act amended the Mineral Lands Leasing Act of February 25, 1920, (para. 3) by specifying that coal leases on National Forest System lands may be issued only after the consent of the Secretary of Agriculture and adherence to conditions the Secretary may prescribe. The act also provides that no lease shall be issued unless the lands involved in the lease have been included in a comprehensive forest land and resource management plan and the sale is compatible with the plan. The act authorizes the issuance of a license to conduct exploration for coal.
- Surface Mining Control and Reclamation Act of August 3, 1977, (91 Stat. 445; 30 U.S.C. 1201-1328). This act enables agencies to take action to prevent water pollution from current mining activities, and also promote reclamation of mined areas left without adequate reclamation prior to this act. This act provides for cooperation between the Secretary of the Interior and states in the regulation of surface coal mining. It also restricts or prohibits surface coal mining operations on National Forest System lands, subject to valid existing rights and compatibility determinations.
- The Federal Land Policy and Management Act of 1976 defines procedures for the withdrawal of lands from mineral entry. It reserves to the United States the rights to prospect for, mine, and remove the minerals in lands conveyed to others and requires the recordation of claims with the Bureau of Land Management.
- Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (CERCLA: 94 Stat. 2767; 42 U.S.C. 9601, et seq). This act provides authority to the Environmental Protection Agency and to other Federal agencies, including the U.S. Department of Agriculture, to respond to release of hazardous substances, pollutants, and constituents. It also provides for joint and several liability to potentially responsible parties (PRPs) for cleanup costs of existing water contamination. See also FSM 2160.
- National Materials and Minerals Policy, Research and Development Act of October 2, 1980, (94 Stat. 2305; 30 U.S.C. 1601-1605). This act restates congressional intent to promote policies that provide for an adequate and stable supply of materials while considering long-term needs, a healthy environment, and natural resource conservation. The act also requires the Secretary of the Interior to improve the availability and analysis of mineral data in Federal land use decision making.
- Energy Policy Act of 2005 (Pub. L. 109–58). The Energy Policy Act (EPA) addresses energy production in the United States, including: (1) energy efficiency; (2) renewable energy; (3) oil and gas; (4) coal; (5) tribal energy; (6) nuclear matters and security; (7) vehicles and motor fuels, including ethanol; (8) hydrogen; (9) electricity; (10) energy tax incentives; (11) hydropower and

geothermal energy; and (12) climate change technology. This act directs how Federal agencies will implement objectives contained within the act pertaining to renewable and non-renewable energy resources and transmission corridors.

- Energy Security Act of June 30, 1980, (94 Stat. 611; 42 U.S.C. 8855). This act directs the Secretary of Agriculture to process applications for leases and permits to explore, drill, and develop resources on National Forest System lands, notwithstanding the current status of the national forest land and resource management plan.
- Executive Order 13212 issued May 18, 2001, (E.O. 13212). This Executive order titled “Actions to Expedite Energy-Related Projects” requires Federal agencies to take actions, to the extent consistent with applicable law, to expedite projects that will increase the production, transmission, or conservation of energy.
- Omnibus Parks and Public Lands Management Act of 1996, (110 Stat. 4093, 16 U.S.C. 497c, subpart j). This act automatically withdraws from all forms of appropriation under the mining laws and from disposition under all laws pertaining to mineral and geothermal leasing all lands located within the boundaries of ski area permits.
- Paleontological Resources Preservation subtitle of the Omnibus Public Land Management Act, 16 U.S.C. 470aaa to aaa-11 (2009). This rule provides for the preservation, management, and protection of paleontological resources on National Forest System lands, and insures that these resources are available for current and future generations to enjoy as part of America's national heritage. The rule addresses the management, collection, and curation of paleontological resources from National Forest System lands including management using scientific principles and expertise, collecting of resources with and without a permit, curation in an approved repository, maintaining confidentiality of specific locality data, and authorizing penalties for illegal collecting, sale, damaging, or otherwise altering or defacing paleontological resources.
- Federal Cave Resources Protection Act (FCRPA) of 1988. This act states that it is the policy of the United States that Federal lands be managed in a manner which protects and maintains, to the extent practical, significant caves. The purposes of the act are (1) to secure, protect, and preserve significant caves on Federal lands for the perpetual use, enjoyment, and benefit of all people; and (2) to foster increased cooperation and exchange of information between governmental authorities and those who utilize caves located on Federal lands for scientific, educational, or recreational purposes. The act sets forth management actions, confidentiality of significant cave locations, describes permitting, prohibited acts, and penalties. The act is guided by implementing regulations at 36 CFR Part 290 – Cave Resources Management. The regulations provide definitions and rules pertaining to the process for nomination, evaluation and designation of significant caves, rules regarding confidentiality of cave locations, and other information specific to cave resource management.
- The Federal Land Policy and Management Act of 1976 as Amended, Public Law 94-579 is the principal law governing how the Bureau of Land Management (BLM) manages public lands. It was enacted for the purposes of establishing a unified, comprehensive, and systematic approach to managing and preserving public lands in a way that protects "the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values."
- Wilderness Act of September 3, 1964, (78 Stat. 890; 16 U.S.C. 1121, 1131-1136). This act provides that, subject to valid rights existing prior to January 1, 1984; wilderness areas are withdrawn from all forms of appropriation and disposition under the mining and mineral leasing laws.

Subsequent acts designating additional National Forest System lands as wilderness may contain specific provisions concerning mineral activities. Patents issued under the mining laws for mining claims staked after passage of this act within wilderness areas shall reserve the surface rights to the United States. The act provides for reasonable access to valid mining claims and other valid occupancies inside wilderness areas. The act also requires the survey of wilderness areas by the U.S. Geological Survey on a planned, recurring basis consistent with the concept of wilderness preservation to determine the mineral values that may be present. This act describes a wilderness as an area which may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value. These geological features are generally identified for wilderness classification purposes.

- Portions of the planning area are designated wilderness areas or wilderness study areas. Designated wilderness areas include the Absaroka-Beartooth Wilderness (917,474 acres) and the Lee Metcalf Wilderness (133,848 acres). These lands are legislatively withdrawn from mineral entry, subject to valid existing rights. The Hyalite – Porcupine-Buffalo Horn Wilderness Study Area consists of 143,965 acres and has not been withdrawn from mineral entry.
- National Environmental Policy Act of January 1, 1970, (83 Stat. 852; 42 U.S.C. 4332). This act requires Federal agencies to use a systematic interdisciplinary approach to ensure the integrated use of natural and social sciences in planning and decision making. It also requires an analysis of probable environmental effects of proposed Federal actions. Generally, decisions on mineral and energy development are subject to this law.

Land Status and Mineral Resources

The regulatory framework for mineral and energy resource exploration and extraction depends upon the type of commodity, the surface and mineral estate ownership, and the land status (public domain or acquired). The Forest Service has authorities to administer minerals on both public domain and acquired lands but they are not the same authorities. Public domain land has never left Federal ownership or jurisdiction. These lands, unless they are subject to a mineral withdrawal, are open to mineral entry under the Mining Laws. Most of the lands (2,966,632 acres; approx. 87 percent of the Custer Gallatin National Forest) within the administrative boundaries of the plan area are public domain.

Acquired lands are those that have been brought into Federal ownership through purchase, condemnation or exchange. Landownership can be transferred with both the surface and mineral estate or separately. The result is that some of the Federal lands include only the surface estate or only the mineral estate. Lands where the Forest Service owns only the surface estate but not the mineral estate are referred to as lands with reserved minerals, or "outstanding mineral rights." According to the Land Status Database (ALPS), there are 154,508 acres of outstanding mineral rights within the administrative bounds of the Custer Gallatin National Forest planning area and approximately 25,000 acres of reserved minerals as well. These areas are found mostly within the Crazy, Bridger, Bangtails landscape area, or the Madison, Gallatin, Absaroka Beartooth landscape area or the Ashland District. This is important because the owner of the mineral rights may develop the mineral estate and typically the Forest Service cannot deny the exercise of those outstanding mineral rights. The Forest Service regulatory authorities for administering mineral activities on these lands are provided for in 36 CFR251.15 and FSM 2830.

Acquired lands where the Forest Service has acquired both the surface and mineral estate have specific authorities with respect to mineral development, depending upon the authority used for the land acquisition. On acquired lands, locatable minerals become leasable.

Current Forest Plan Direction

Forest planning for the Custer Gallatin National Forest was originally conducted in two separate planning efforts. During 2014, the two former national forests (Custer National Forest and Gallatin National Forest) were administratively combined into a single national forest unit. Both the 1986 Custer forest plan and the 1987 Gallatin forest plan describe forestwide and management area specific goals, objectives, and standards related to management of a variety of resource values found within the respective planning areas.

Within the Custer forest plan, a management area (E) was identified specifically to address and recognize known Federal mineral and energy resources that are found in those areas. Management areas B and D also have goals to facilitate or accommodate minerals and oil and gas development. Similarly, the Gallatin forest plan identified mineral emphasis areas associated with active or recently active locatable mineral activities (management area 24). Management area 24 also states that “As other exploration and development takes place, total acreage in this management area will increase.” While such development has occurred at Stillwater Mining Company’s East Boulder Mine, there have been no corresponding management area 24 acreage increases since 1987.

Both forest plans provided forestwide and management areas goals, objectives and management standards which principally focused on the management of locatable, leasable, and mineral material resources. The Custer forest plan provides management direction related to paleontological resources.

Neither respective forest plan provides direction for a variety of geologic resources such as natural geologic hazards. In these instances, management direction defaults to overarching Federal legislation and associated regulations pertaining to Forest Service management activities.

Leasable mineral activity direction for the Custer National Forest has been modified by oil and gas leasing environmental impact statements and decisions conducted after the 1986 forest plan was approved resulting in Amendments 1, 5, 21, and 29. A subsequent oil and gas leasing environmental impact statement and decision were prepared on the Beartooth Mountains in 1993 which resulted in Forest Plan Amendment 19. Similarly, an oil and gas leasing environmental impact statement and decision were prepared on the South Dakota portion of the Sioux District in 2007 which resulted in Forest Plan Amendment 40. The Gallatin National Forest has not conducted any environmental impact statements and decisions since forest plan approval in 1987. This is discussed in more detail below.

In 1991, the Custer forest plan was amended (Amendment 8) to provide management standards and guidelines for cave and karst geologic resources in response to passage of the 1988 Federal Cave Resource Protection Act (FCRPA). The management standards prescribed in Custer forest plan Amendment 8 have not been fully applied or implemented.

There is no forest plan direction specific to cave resources in the Gallatin forest plan as amended.

Existing Condition

The National Forest System lands managed by the Custer Gallatin National Forest lie within the Middle Rocky Mountain and Great Plains physiographic provinces (Fenneman and Johnson 1946). The distance from the western portions of the national forest to the eastern portions covers approximately 400 miles and contains a high degree of geologic variability within this landscape. The landscape ranges from typical basin and range mountain/valley physiography in the western portions of the planning area to dissected, but relatively flat lying tablelands dominated by prairie grass/shrub lands in the eastern portions of the planning area.

Given this expansive landscape, coupled with the complexity and diversity of geologic environments contained within it, the area is best described and understood if broken down in to smaller landscape areas. The analysis area will be discussed based on five landscape areas termed the Madison, Henry's, Gallatin and Absaroka Beartooth Mountains; the Bridger, Bangtail, and Crazy Mountains; the Pryor Mountains; the Ashland District; and the Sioux District.

Geology and Mineral Occurrence

Madison, Henrys Lake, Gallatin, Absaroka and Beartooth Mountains

The geologic environments of the Madison, Henrys Lake, Gallatin, Absaroka and Beartooth Mountains landscape area contains rocks representing the span of geologic time. Surface geology consists of Archean, PreCambrian, Paleozoic, Mesozoic and Cenozoic aged rocks. Tertiary aged igneous (volcanic) rocks associated with the Yellowstone Plateau and Absaroka Volcanic Centers dominate west of the Boulder River, while portions east of the Boulder River are dominated by Archean and Pre-Cambrian aged igneous (granite) and metamorphic (gneisses and schist) rocks. Eastern portions of this area have been termed the Beartooth Uplift. Western portions of this area are known as the Absaroka volcanic province.

The Absaroka volcanic province consists of deeply eroded andesitic and basaltic stratovolcanoes and the coalesced deposits of reworked material derived from tuffs and a variety of intrusive rocks. These Eocene volcanic rocks constitute the main mass of the Absaroka Range for which the field is named, as well as much of the northern Gallatin Range. Much of the southwestern part of the Absaroka volcanic province is covered by Quaternary rhyolites of the Yellowstone Plateau (Lopez 2001, Smedes and Protska 1972, Hiza 1998, Tysdal 1966).

The northern flank of the Beartooth Uplift hosts the ultramafic layered intrusive structure known as the Stillwater Complex (Czamanske and Zientek 2002). This globally unique geologic feature contains significant amounts of commercially important locatable minerals which includes platinum, palladium, gold, silver, copper, chromium, and rare earth minerals. Many of these minerals have been classified as strategic to the national interest and defense. The area is currently being mined for platinum and palladium mineral resources. Sedimentary rocks of Paleozoic and Mesozoic age are found along the northern and eastern portions of the Beartooth Uplift. These areas have been subjected to extreme tectonic deformation and are often oriented in a vertical to overturned orientation (Geraghty 2013, Van Gosen et al. 2000, Lopez 2001, Lopez 2005, Foose et al. 1961).

Other areas with known occurrences of significant mineral deposits include the Cooke City (New World Mining District) Emigrant, Independence, Speculator, Jardine, and the Hellroaring/Line Creek Plateau portions of the Custer Gallatin. The Cooke City area hosts a variety of base metal deposits, which have been exploited since the 1880s. This area was the subject of a 1996 mineral interest purchase by the United States. In exchange for $65 million in Federal land and other assets, the Noranda Crown Butte agreed to abandon its mining plans and create a $22.5 million fund necessary to address past mining restoration needs. The area additionally was withdrawn from all forms of mineral (locatable) entry, leasing and disposal. The Hellroaring/Line Creek Plateau area of the Custer Gallatin host previously explored and mined podiform chromite deposits. Much of these deposits and associated development occurred within lands now designated as the Absaroka-Beartooth Wilderness. The Forest Service previously contested the validity of these claims. The Interior Board of Land Appeals found that the claims did not contain sufficient mineral value to hold the mineral claims. Since that time, no subsequent mineral activities have taken place.

Other areas that hosted historic production of locatable mineral resources include the western and southern margins of the Absaroka Mountain Range. Most notable are the Emigrant Mining District and the Jardine/Crevice Mountain mining areas. The Emigrant area hosts placer gold deposits as well as lode deposits of copper and molybdenum, which have been the subject of both small and large scale mining efforts conducted from the 1880s to present. Jardine/Crevice Mountain area mineralization is associated with lode deposits (disseminated ore) as well as native gold housed within veins of quartz which run through the adjacent rock mass. Recent mineral development has been conducted in these historic mining areas.

The Independence and Speculator mineralized mining areas are located in the middle portion of the Custer Gallatin, within the Boulder River drainage. These mining districts host lode deposits principally explored and mined for gold. No recent mineral production activities have been undertaken in these areas.

The high-elevation landscapes of the Madison, Henrys Lake, Gallatin, Absaroka and Beartooth Mountains landscape area of the forest have been actively eroded by streams and glaciers since the last ice age, leaving behind a landscape of glacial features including cirques, moraines, and u-shaped drainages. Remnant and active glaciers and rock glaciers are present throughout the area (Graf 1977, Krimmel 2002, Locke 1989, Seifert et al. 2009, Seligman 2009).

Bridger, Bangtail, and Crazy Mountains

This region of the national forest occupies the transition between the Northern Rocky Mountains and Great Plains physiographic provinces and includes areas of complex structural geology. The geologic environment of the Bridger, Bangtail and Crazy Mountain portion of the Custer Gallatin is composed of a mix of rock types depending on the specific mountain range being described.

The Bridger Range includes rocks consisting of Archean (greater than 2.5 billion years) metamorphic gneisses, to conglomerates of Proterozoic age (about 1.4 billion years), and Paleozoic sedimentary rocks that were deposited in the warm shallow seas that once covered this area (about 540-100 million years ago). The Bridger Range was formed by at least five major mountain-forming events; these structures are evident in the rocks exposed at the surface. The strata of the Bridger Range have been steeply faulted along its eastern edge to form a continuous, north-trending, east-verging, asymmetric anticlinorium. Glaciation has resulted in formation of cirques, glacial valleys, and other erosional features. Active rock glaciers remain in the northern portion of the Bridger Range. (Skipp et al. 1999, Locke and Lageson 1989, Pierce 2004, Locke 1989).

The Bangtail Mountains contain both Cenozoic (Tertiary) Livingston Formation volcanics and Tertiary aged sedimentary units of the Fort Union Formation. The area has been tectonically deformed by back-thrusting and consists of strata that are overturned in the northern portion and more gently dipping to the southeast. The Bangtails are formed entirely in Tertiary/Cretaceous andesitic sandstones and siltstones derived from the Elkhorn Mountains south of Helena (thus transported eastward prior to formation of the Bridger Range; Skipp et al. 1999, Locke and Lageson 1989).

The Crazy Mountains within this landscape area are composed of Cenozoic (Tertiary) aged sedimentary units of the Fort Union Formation which have been locally intruded and metamorphosed by Tertiary aged igneous alkaline rocks. The igneous Big Timber stock forms the core of the Crazy Mountains and is part of the Central Montana Alkalic Province, which is characterized by high contents of sodium and potassium. The igneous core, sills, dikes, and metamorphosed sedimentary rocks are more resistant to erosion than the surrounding areas of sedimentary rock. Extensive faulting, tectonic movement and subsequent glacial erosion of the Crazy Mountains have occurred over time to produce the dramatic landscape of today. Numerous remnant glaciers are present in the Crazy Mountains (Johnson et al. 2005, du Bray et al. 2006, Garrett 1972, Pierce 2004, Locke 1989, Graf 1977).

Pryor Mountains

The geology within the Pryor Mountains is dominated by the presence of Paleozoic sedimentary rock units (Ordovician, Mississippian, and Permian) with lesser exposures of Mesozoic (Triassic, Jurassic and Cretaceous) sediments located along the west and south portions of the area. Igneous and metamorphic rocks are largely absent except in isolated locations on the northern scarps of East Pryor Mountain. Structurally, the area consists of two fault bounded blocks, which both dip to the southwest with steep north and northeast oriented scarp slopes. The Pryor Mountains were not affected by glaciation, resulting in mountainous topography unique to Montana. Large portions of the Pryors consist of a karst landscape that contains many known caves. Several of these caves were previously mined for uranium minerals (Lopez 2000, Campbell 1978, NRCI 1993, Van Gosen et al. 1996). Known mineral occurrences within the Pryor Mountains include locatable grade limestone and uranium.

Leasable mineral occurrence and development (such as oil, gas, and coal) within the Pryor Mountains are discussed later in this report.

Ashland District

The Ashland District is composed entirely of Cenozoic (Tertiary) aged sedimentary units of the Fort Union Formation, which is made up of layered sandstones and claystone strata. In the southern portion of the district, the Tertiary aged Wasatch Formation forms a more resistant cap layer on top of the underlying Fort Union Formation. The area has not been subject to large-scale tectonic movement. Generally, strata are gently dipping to flat in orientation (Wheaton et al. 2008. Vuke et al. 2001a, Vuke et al. 2001b).

Significant volumes of sub-bituminous coal are located within this landscape area within the Tongue River Member of the Fort Union Formation. Areas immediately adjacent to the Ashland District had been proposed for coal mine development. The proposal was the subject of an environmental impact statement being conducted by the Montana Department of Environmental Quality. The proposal for the Otter Creek Coal Mine was recently abandoned when Arch Coal withdrew their permit application.

Surface mining of coal resources within the bounds of the Ashland District are currently precluded through enactment of the Surface Mining Control and Reclamation Act (SMCRA) of 1977. The provisions of the Act do not address underground coal mining or the development of coal bed methane energy resources.

The region that lies immediately south and east of these districts has hosted large-scale coalbed methane extraction activities on both private and Bureau of Land Management lands. No coalbed methane exploration or development activities have taken place within the Ashland District. Currently, coalbed methane production and development south of the Ashland District have been significantly curtailed with the development of hydrologic fracturing of shale formations employed throughout the nation.

Leasable mineral occurrence and development (oil, gas, and coal) within the Ashland District is additionally discussed later in this report.

Sioux District

The Sioux District is composed entirely of Cenozoic (Tertiary) sandstones, and claystone strata of the Fort Union Formation and younger (Eocene and Miocene) Arikaree and White River Formations (Farhenbach and Sawyer 2011, Vuke et al. 2001c). These rocks formed from volcanic ash deposits and serve as a cap rock over the softer sedimentary layers of the Fort Union Formation. The area has experience some degree of tectonic deformation with strata gently to moderately dipping. These geologic processes have produced the dominant butte/highlands topography found with the Sioux District. The area contains deposits of lignite coals and associated uranium deposits (Farhenbach and Sawyer 2011, Jacob 1976, Pipiringos et al. 1965) within the Tongue River Member of the Fort Union Formation. Large scale mining of these uranium mineral resources was conducted during the 1960s. Additionally, exploration and small-scale coal and uranium mining occurred through the Sioux District. These will be further discussed later in this assessment.

Leasable mineral occurrence and development (oil, gas, and coal) within the Sioux District is also discussed later in this report.

Locatable Mineral Withdrawals

The Custer Gallatin National Forest contain certain specific lands that have been precluded from exploration, development and production of locatable mineral resources (withdrawn from mineral entry). These areas consists of administrative sites, existing ski areas, campgrounds or other areas of capital improvements, wilderness areas, and wild portions of streams and adjacent lands designated under the Wild and Scenic River Act. Both the Custer (Appendix IV) and Gallatin (Appendix D) original forest plans included a listing of sites where locatable mineral withdrawals had been enacted. In total, 80 sites were identified in both forest plans. The sites were listed in one of three categories related to future withdrawal continuation, withdrawal modification, or withdrawal revocation.

Discussions with BLM personnel and review of the BLM's LR 2000 Geodata database reveals that although recommendations had been made, no determination on these recommendations have been forthcoming. Generally, mineral withdrawals enacted prior to the Federal Lands Planning and Management Act (FLPMA) of 1976, did not have a termination date. After the Act was established, most enacted withdrawals were termed at 20 years with a provision for automatic revocation.

The process of processing future areas of mineral withdrawals are defined at section 204 of the Federal Lands Planning and Management Act and at 43 CFR 2310. Areas that may be considered for future withdrawals may have significant financial, social, or cultural interest. The largest land positions currently withdrawn from mineral entry within the Custer Gallatin include the Absaroka-Beartooth (917,474 acres) and Lee Metcalf Wilderness (133,848 acres) areas. A total of 1,051,322 acres of designated wilderness (approximately 30.7 percent) has been withdrawn from mineral entry within the 3,423,395 acres of the Custer Gallatin National Forest.

In 1997, 22,065 acres of Federal lands within the New World Mining District, were withdrawn from location and entry under the mining and mineral leasing laws, except oil and gas, for a period of 20 years (see Public Land Order No. 7282). Appendix C of Public Law 106-113, the Fiscal Year 2000 appropriations bill, included a section that withdrew approximately 26,223 acres of federally owned lands and interests in lands within the New World Mining District from all forms of entry, appropriation, and disposal under the public land laws, and from location, entry and patent under the mining laws, and from disposition under all mineral and geothermal leasing laws. This acreage is larger than the 20-year withdrawal due to inclusion of private lands within the withdrawal boundary. This withdrawal is for an indeterminate term and supersedes the 20-year withdrawal both in the duration and scope. As a result, the identified Federal lands in the New World Mining District are now permanently withdrawn from entry, appropriation, and disposal under the public land laws, and from location, entry and patent under the mining laws, and from disposition under all mineral and geothermal leasing laws.

Additionally, in November 2016, a two year segregation process began on about 30,000 acres in the Jardine and Emigrant Creek areas, during which the Forest Service will conduct environmental analysis to evaluate a twenty year mineral withdrawal for new mining claims.

Geologic Areas of Interest

The geologic events and processes described above have created a host of geologic bedrock formations, structures, and a complexity of diverse landscape features located across the Custer Gallatin National Forest. Noteworthy examples include:

- Well exposed large-scale faulting, which has contributed to the formation of the scenic mountain ranges found throughout the western and central portions of the planning area. These magnificent features have attracted people from around the world, including scientists and tourists.
- Prominent Pleistocene glaciation features such as u-shaped valleys, arêtes, alpine glacial lakes, thick deposits of ground moraine, and hanging valleys further enhance these stunning landscapes.
- Unglaciated subalpine highlands containing extensive cave and karst formations, including four ice caves. These features are unique to the northern Rocky Mountains.
- Further east within the planning area, steep sided erosion resistant remnant buttes of the Sioux District provide a stark and dramatic contrast to the adjacent rolling and dissected pine savannas.
- Exposure of geologic formations known to contain important paleontological resources.

Additionally, there are specific geologic areas of interest which have been formally designated as notable geologic areas. Areas which have been given these designations are listed in Table 1.

Table 1. Designated or developed geologic areas of interest

Geologic Areas of Interest in the Planning Area	Ranger District	Description
Earthquake Lake Geologic Area	Hebgen Lake	Visitor center and numerous developed interpretive waysides provide interpretation of the 1959 Earthquake.
Bangtail Botanical and Paleontological Special Interest Area	Bozeman	Occurrence of Tertiary (Eocene) mammalian fossils
Middle Fork Canyon National Natural Landmark	Bozeman	Middle Fork Canyon illustrates rocks deformed by the earth's tectonic movement. Few places more clearly illustrate the effects of erosion and stream superposition.
Gallatin petrified forest	Gardiner	Widespread occurrence of petrified wood available for public collection via permit. Signed interpretive trail
Natural Bridge	Yellowstone	Interpretative facilities related to Karst topography; Main Boulder River disappears underground and reappears on cliff face creating dramatic waterfalls
Capital Rock National Natural Landmark	Sioux	Designated for uniqueness of geologic formation due to uplift and erosion within the surrounding prairie environment. The area is a remnant of the once continuous blanket of Tertiary deposits that covered much of the Great Plains. Late Cretaceous, Paleocene, Oligocene, and Miocene strata are well displayed.
The Castles National Natural Landmark	Sioux	Designated for uniqueness of geologic formation due to uplift and erosion within the surrounding prairie environment. Steep-walled, flat-topped buttes standing 200 to 400 feet above the surrounding prairie, The Castles contains exposed rock of Upper Cretaceous, Paleocene, Oligocene, and Miocene Ages. Cretaceous and Tertiary beds contain a variety of flora and fauna fossils.
Big Ice Cave	Beartooth	Interpretative facilities related to the formation of Ice Caves within the Pryor Mountain cave/karst landscape

Caves and Karst

Caves and karst areas represent unique geologic features, occupying only 10 to 20 percent of the Earth's land area (Palmer 1991). They are considered nonrenewable resources with significant biological, hydrological, mineralogical, scientific, cultural, recreational, and economic values (British Columbia Ministry of Forests 2003a, FCRPA). Karst topography results from the dissolving action of acidic water on soluble bedrock (usually limestone, dolomite, marble, and, to a lesser extent, gypsum). Karst originates from internal drainage, subsidence, and collapse triggered by underlying voids (Palmer 2001), resulting in the formation of fissures, epikarst, vertical shafts, sinkholes, sinking streams, springs, complex subsurface drainage systems, and caves (Gutierrez et al. 2014, Stokes et al. 2010, USFS 2007, Palmer 2007, British Columbia Ministry of Forests 2003b).

Caves and karst on National Forest System lands host important biologic resources and play a critical role in the overall biological productivity of an area. Often, the biological importance of these lands are related to changes in light, temperature, and humidity between the cave entrance and areas deep within caves. Cave entrances provide microclimates that can result in occurrences of plant populations that are different from those on the surrounding landscape. Unique suites of specialized fauna and flora can be present that are adapted to cave entrance and cave interior environmental conditions (Ramsey 2004). Caves lack sunlight, which results in highly specialized ecosystems evolved for survival in low-energy and lightless environments. In addition to this rich variety of plants and animals, the subterranean karst environments provide unique microbiological habitats (Gutierrez et al. 2014).

Very little is known about karst aquifer ecosystems under National Forest System lands, their importance for biodiversity, or their importance to the hydrologic systems into which they discharge. Animals that occupy cave or karst aquifer habitats have been identified at depths of up to 600 meters (Longley 1992). Aquifer ecosystems have stable and confined environments that can result in high levels of endemism and high proportions of relict species compared with surface environments (USDA Forest Service 2007). Ground water level, flux, and quality are the three attributes of greatest significance to karst aquifer ecosystems. Ground water level and flux determine the quantity of ground water available to support these ecosystems while karst water quality may determine if the area is capable of supporting these unique ecosystems. No specific information related to Custer Gallatin karst aquifer fauna is known to exist.

Occurrences of cave biota on the Custer Gallatin National Forest have been documented in several areas and include microbial moonmilk communities, packrats, rattlesnakes, gnats, mites, cave crickets, horsehair worms and numerous bat species. Bat species and their required biological habitats have been documented in caves and karst across the national forest. Threats to bats and bat habitat have been identified as one of the most critical biological issues associated with caves (Elliott 2005), as a result of invasive white nose syndrome disease in the United States and Canada (USFWS 2016).

Dark, dry conditions in caves can result in preservation of potentially significant cultural and paleontologic resources (Hildreth-Werker and Werker 2006, Ramsey 2004). Such nonrenewable resources have been documented on the Custer Gallatin and are primary information sources about past biodiversity, ecosystems, and cultures.

Deposition and erosion in caves form rare rock and mineral features from calcite, gypsum, and silica minerals. Cave formations are called speleothems and include stalactites, stalagmites, fossils, flowstone, cave popcorn and scallops, all of which have been documented in Custer Gallatin National Forest caves.

There are numerous inventoried caves and likely many uninventoried caves on the Custer Gallatin. Inventoried caves contain biotic, cultural, mineralogical, paleontologic, geologic, hydrologic, and recreation resources. Caves are also often components of a larger karst landscape, particularly in areas with high densities of cave openings. There are several areas on the Custer Gallatin that can be defined as karst landscapes.

Cave exploration is a form of recreation that annually attracts hundreds of visitors to the national forest to observe unique cave resources. This ranges from families visiting Big Ice Cave picnic area to cave explorers using technical rope systems to explore more challenging caves. Cave resources are generally considered nonrenewable resources and are susceptible to direct visitor impacts such as physical damage to fragile minerals and speleothems, unauthorized excavation of cultural and paleontologic resources, disturbance of hibernating and roosting bats, and introduction of white-nose syndrome by human transport of material from other caves.

Forestwide Cave Resources

More than 90 percent of the known caves in Montana are solution caves formed in the 320 to 360 million year old Mississippian aged carbonate rocks typically, Madison limestone (Campbell 1978). While the Madison limestone would appear to host the majority of cave and karst features, a smaller number of caves and karst resources likely occur in other carbonaceous rock units, such as the Ordovician

Bighorn dolomite, Devonian Jefferson dolomite and various Cambrian limestones (Campbell 1978). The majority of known caves on the Custer Gallatin National Forest are solution caves in Madison limestone and a lesser amount occur in Cambrian limestone.

Other types of caves within the Custer Gallatin include glacier caves, which form by melting of channels inside glacial ice (Palmer 2007). These type of cave resources may exist in glaciers present in the Absaroka, Beartooth, and Crazy Mountains. Talus caves or boulder caves consist of voids between boulders in talus that accumulates at the base of cliffs or steep slopes (Palmer 2007) and are likely present throughout the mountainous landscapes within the national forest. Caves in Pleistocene travertine formed by hot springs exist on the Gardiner Ranger District (Campbell 1978, Campbell 1993).

The Sioux and Ashland Ranger districts have significantly different bedrock geology than the rest of the Custer Gallatin and do not contain large masses of carbonate bedrock. Because there are no large areas of carbonate bedrock on the Sioux and Ashland Ranger Districts, no landscapes traditionally considered as “karst” have been identified in these areas, but there are numerous small caves and alcoves formed in sandstone outcrops.

Cave Resources by Landscape Area

Madison, Henrys Lake, Gallatin, Absaroka and Beartooth Mountains

Limestone formations occur throughout these mountain ranges and have largely been uplifted, folded, and faulted through orogenic events that occurred in the geologic past. Tectonic uplift has resulted in modification or destruction of many previously formed karst landscapes and cave features in the area. Most known caves in this landscape area do not have long passage lengths and are often controlled by bedding plane contacts in the bedrock. In several instances, limestone bedding planes and cave openings in this landscape area act as karst features that convey water downgradient to feed seeps, springs, and streams.

There are several known caves in portions of this landscape area in Madison limestone, including portions of the Gallatin Range on the Bozeman Ranger District and portions of the Absaroka and Beartooth Mountains on the Yellowstone and Beartooth Ranger Districts. There are small caves formed in travertine on the Gardiner Ranger District (Campbell 1978, Goodrich 1991, Campbell 1993). Additional caves may also exist in areas of Madison limestone and could be documented through additional inventory and monitoring work.

Human use of caves in the Beartooth and Absaroka Mountains has resulted in damage to cave resources, including broken speleothems, graffiti and litter.

Only one cave in the Beartooths has been evaluated and designated as a significant cave. Other known caves in this area have not been specifically evaluated for or designated as significant per the Federal Cave Resources Protection Act. Forest Plan Amendment 8 requires that all caves on the Custer Gallatin be considered as significant until evaluated. Some known caves contain ice and ice columns (Hose 1992). Ice caves are highly sensitive to their surrounding environment and serve as archives for changes in climate and air quality (Palmer 2007). Cave biota have been documented in the Beartooth Mountains (several bat species) and Gallatin Range (moonmilk, mites, gnats, bats) (USDA Forest Service 2016, Hose 1992). Several known caves in areas of uplifted limestone contain hydrologic features, such as siphons, spring recharge, and subsurface stream flows (Campbell 1978, Hose 1992, Campbell 1993).

Bridger, Bangtail, and Crazy Mountains

There are several known caves in the Bridger Mountains (Campbell 1978, Goodrich 1991, Hose 1992, Campbell 1993). Tectonic uplift has resulted in modification or destruction of many previously formed karst landscapes and cave features in the Bridger Mountains. Most known caves in the Bridger Mountains do not have long passage lengths and are often controlled by bedding plane contacts in the bedrock. Additional caves may also exist in areas of Madison limestone and could be documented through additional inventory and monitoring work.

Known caves in this landscape area have not been specifically evaluated for or designated as significant per the Federal Cave Resources Protection Act. Documented Bridger Mountains cave biota includes moonmilk, gnats, several bat species, packrats (Hose 1992). Some caves in the Bridger Range contain paleontological and cultural resources, including petroglyphs and historic signatures (Hose 1992). These caves have been previously evaluated by archeological surveys and excavations. If evaluated per the Federal Cave Resources Protection Act, many Bridger mountains caves would likely qualify as significant due to cave biota, speleothems, mineralogy, and historic and cultural resources.

Human use of caves in the Bridger Mountains has resulted in damage to cave resources, including broken speleothems, graffiti, and litter.

Pryor Mountains

The Pryor Mountains have been inventoried for cave resources through multiple past and ongoing efforts (NRCI 1993, Byers 2012, USDA 2016, National Speleological Society personal communications). Given the overall flat-lying and extensive distribution of limestone in the Pryors and numerous surficial karst features such as sinkholes, dolines, traps, and springs, it is likely that the known caves are part of a larger overall karst landscapes on Big Pryor and East Pryor Mountain that convey water downgradient to feed seeps, springs, and streams.

There are four known significant caves containing ice in the Pryor Mountains (USDA 2016, NRCI 1993, and Campbell 1978). Ice caves are highly sensitive to their surrounding environment and serve as archives for changes in climate and air quality (Palmer 2007).

Several caves in the Pryors have been previously excavated for cultural resources (Byers 2010, Bonnichsen et al. 1986), paleontologic resources (Hill 2001, Bonnichsen et al. 1986, Woodman 1984) and paleoclimatic data (Lyford et al. 2003). Presence of these cultural and paleontological resources has resulted in designation of several caves as significant per the Federal Cave Resources Protection Act (USDA Forest Service 2016, NRCI 1993). One of these previously excavated caves is covered by a protective grate to prevent unauthorized excavation of paleontologic resources. Another cave was previously illegally excavated by unknown parties.

Custer Gallatin National Forest cave resource management activities currently focus on the Pryor Mountains, which have the highest density of significant caves on the Custer Gallatin National Forest and within the Forest Service’s Northern Region (USDA Forest Service 2011). Additional caves are documented nearly every year in the Pryors and several nominations for additional significant caves are pending.

Human use of caves in the Pryor Mountains has resulted in damage to cave resources, including removal of calcite crystals, broken speleothems, graffiti, litter, and theft of paleontologic resources.

Management activities include limited educational efforts, inventory, mapping, monitoring, trash clean-up, bat inventory work, cave evaluations and significance determinations, and maintenance of interpretive panels and a walkway and boardwalk system at Big Ice Cave.

Ashland and Sioux Districts

No karst landscapes are known or suspected to exist in this landscape area due to the lack of carbonate bedrock. Caves on the Ashland and Sioux Ranger District are different types of caves than are found elsewhere on the Custer Gallatin and can be described as eolian (wind formed) caves. There are numerous small caves in portions of the Sioux District, most of which do not contain extensive passageway or hydrologic features. Only one Sioux District cave has been designated significant per the Federal Cave Resources Protection Act. Additional Sioux District caves are known to contain archeological resources (such as rock art) and host bat populations. Only two small caves are known on the Ashland District. These known cave resources contain paleontologic and archeologic resources (Smyers 2012). Other caves likely exist on the Ashland and Sioux Ranger Districts. Specific cave inventories and evaluations have not been completed for either the Sioux or Ashland Districts. Given the generally dry nature of caves systems and historic and prehistoric tribal use of some of these landscapes, it is likely that such caves would be deemed significant per the Federal Cave Resources Protection Act due to archeologic and cultural resources.

Human use of the one significant cave on the Sioux District has resulted in damage to cave resources, including graffiti, litter, damage to historic signatures, and damage to pictographs.

Paleontological Resources

Paleontological resources are broadly synonymous with “fossils,” as defined by statute (the Paleontological Resources Preservation subtitle of the 2009 Omnibus Public Land Management Act, 16 U.S.C. 470aaa to aaa-11 and in recently enacted Forest Service regulations (36 CFR Part 29). Past practice in the Forest Service in the absence of statutory authority and/or regulations has been to assign various levels of significance to fossil occurrences and to recommend management commensurate with significance. However, neither the 2009 Act nor the regulations recognize differing levels of significance of paleontological resources. Rather, the Act and the regulations stipulate that all paleontological resources on National Forest System lands shall be managed by the Secretary of Agriculture using scientific principles and expertise.

The current forest plan for the Custer National Forest provides management direction related to paleontologic resources (pp. 5, 31, 32, 165 and 173), while the Gallatin forest plan does not provide direction pertaining to paleontological resources. Lands that currently comprise the Custer Gallatin National Forest, particularly the eastern portions, have an abundance of paleontological resources, particularly in the Cretaceous and Tertiary aged formations. There has not been any expressed interest in commercial collecting of these resources but recreational rock picking does occur. The Forest Service has been conducting active inventory of paleontological resources on the Sioux District over the last several years as a part of the Passport in Time (PIT) program. These efforts have resulted in the discovery of numerous vertebrate fossil specimens.

Other portions of the Custer Gallatin have had paleontological investigations. Areas immediately adjacent to the Pryor Mountains have been explored for the presence of Paleozoic and Mesozoic aged vertebrates. Additionally, caves and traps within the karst topography of the Pryor Mountains houses Quaternary fossil evidence (Bonnichsen et al. 1986, Oliver 1984, Woodman 1984, and NRCI 1993).

The Bangtail Mountains are known for the presence of fossils that document Eocene mammalian macroevolution, faunas and flora diversification, and climatic change. The area is also believed to represent unique documentation in the fossil record pertaining to mammalian evolution during the Paleocene epoch.

Undiscovered paleontological resources may exist in other portions of the national forest. As an example, recently a large fossilized bone was located in the Derby Mountain portion of the Yellowstone District. This area is not widely known for fossil occurrence.

Geologic Hazards

Geologic hazards are part of the natural environment of the forest plan area. Hazards can include unstable landforms such as landslide prone areas, cliffs or rockfall areas. Changing landforms due to active seismicity, as well as sinkholes that open unexpectedly can take place. Freezing and thawing result in destabilizing steep slopes and creating rock falls. These types of geologic hazards are not generally problems unless associated with forest infrastructure and places where the public might be.

Geologic hazards may also consist of naturally occurring minerals and elements located with bedrock or resultant soils which are naturally a part of the landscape. Management actions within areas known to contain these types of geologic hazards have the potential to create possible human exposures.

In 2010, the Custer Gallatin National Forest conducted a focused assessment of potential geologic hazards related to campground and other developed sites within the planning area. Two separate evaluations were conducted at that time since the two national forests had not yet been combined into a single unit. Geologic hazards evaluated at that time included flooding, earthquakes, debris flows/mass wasting, erionite presence and radiological hazards associated with uranium occurrence. The interdisciplinary team that conducted these assessments determined that the Custer Gallatin National Forest is in compliance with policy and direction in each of the areas evaluated with the possible exception of flooding.

Erionite/Offretite

The Arikaree and White River geologic formations within the Sioux District contain naturally occurring amounts of asbestos like fibrous minerals known as erionite and offretite (Van Gosen et. al. 2013 and NIOSH 2015). The presence of erionite has also been documented within close proximity to national forest lands within the Yellowstone drainage. Erionite has been classified as cancer causing by a number of health authorities. Literature pertinent to erionite strongly suggests that adverse health implications are associated with long term exposure (Dogan, Dogan, and Emri 2005). Occurrences of these minerals have been confirmed on portions of the Sioux District (NIOSH 2015) and implications to some management actions have been evaluated. Land management actions such as timber harvest and road maintenance and surfacing have been undertaken within the bounds of the Sioux District.

Offretite differs in cation composition within the crystalline matrix as compared to erionite. Other characteristics such as mineral geometry are similar to that of erionite. However, the potential health effects due to offretite exposure has not been tested. Currently, neither the Custer nor Gallatin forest plans provide management direction related to erionite or offretite specifically or geologic hazards more broadly.

Uranium

Uranium occurrence within the Custer Gallatin National Forest is associated with three principal locations. These include the Sioux District and the Pryor Mountains, and the Goose Lake portion of the

Beartooth District located within the Madison, Henrys Lake, Gallatin, Absaroka and Beartooth Mountains landscape area.

The Fort Union Geologic Formation located within the Sioux District contains naturally occurring uranium minerals. Uranium mineral occurrence and production within the Sioux District is associated with two types of ore deposits: sandstone deposits, and uraniferous lignite beds (Kerschen et al. 2003). Exposure of uranium minerology can occur both naturally and due to management activities such as road building or mining. Large scale mining, principally in the North Cave Hills and to some degree, the South Cave Hills and Slim Buttes, has significantly increased potential human exposure. Studies associated with the Riley Pass CERCLA[1] action have determined that some radiation exposure exceeds five times naturally occurring levels. Further detailed discussion of uranium mining on the Sioux District is provided below.

During the late 1940s through the early 1950s, uranium mining and exploration were active near Goose Lake, in the general vicinity of Cooke City Montana. Additional exploration and production of uranium was conducted within the Pryor Mountains. Both of these areas are within the Beartooth Ranger District within the Madison, Henrys Lake, Gallatin, Absaroka and Beartooth Mountains landscape area.

Initial discovery of uranium within the Pryor Mountains was made in 1955 on East Pryor Mountain on the Old Glory Claim. A total of 315 claims were staked in the Pryor Mountains. The largest deposits were found on Big Pryor Mountain along the western flank (Minobras 1977). Most of the old mine workings, like the Dandy, Marie and Swamp Frog mines, are located along the lower flanks of the Pryor Mountains on BLM land bordering national forest. The Old Glory, Sandra, and Blasted Cave mines are within land administered by the Forest Service. There has been extensive exploration throughout the Pryor Mountains portion of the national forest. Exploration consisted of surface trenches and pits, and enlargements of naturally occurring limestone caverns where the ore bodies are found in collapsed areas that have been brecciated and re-cemented by silica (Minobras 1977 and Kerschen et al. 2003).

To date, the Custer Gallatin has identified, designed, and implemented reclamation efforts related to past uranium mining and potential human health and safety issues through mine hazard closures and abatement actions. These actions have been carried out at both the Old Glory and Sandra mines located on Forest Service-managed surface. To date, no reclamation actions have been implemented in the area of the Blasted Cave uranium mine. The Custer Gallatin continues to periodically monitor the closed mine locations for trespass and vandalism by the public. Breaches of previously implemented reclamation actions continue to occur. Given the location of these abandoned mine sites, adjacent to an existing Forest Service managed road system, it is highly anticipated that incursions into these areas will continue.

Currently, neither the Custer nor Gallatin forests plans provide any degree of management direction related to uranium exposure specifically or geologic hazards more broadly.

Mass Wasting

The term mass wasting is defined as the movement of in-place landforms in a downslope direction under the influence of gravity. This term includes processes often referred to as landslides and debris flows. These geologic processes can vary significantly in scale and usually are associated with over steepened slopes, weak underlying geologic conditions, or excessive slope loading associated with

[1] CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act of 1980

saturated soils. Examples of these features within the Custer Gallatin National Forest range from the 1959 Hebgen Lake earthquake and subsequent mass wasting which dammed the Madison River, to the 2011/2012 small-scale debris flows that occurred across the Ashland and Sioux Districts as a result of intensive precipitation events in areas where vegetation has been removed by fires and soils modified. Debris flows are often associated with intensive post-fire precipitation events and have occurred through the planning area.

Currently, neither the Custer nor Gallatin forests plans provide any degree of management direction related to mass wasting exposure specifically or geologic hazards more broadly.

Abandoned Mines and Mining Related Hazards

To fulfill its obligations under the Comprehensive Environmental Response, Compensation and Liability Act, the Forest Service's Northern Region identified and characterized abandoned and inactive mines with environmental, health, and/or safety problems affecting National Forest System lands. As part of this effort, two separate inventories of abandoned and inactive mine sites were completed by the Montana Bureau of Mines and Geology. These inventories were conducted for the Gallatin National Forest in 2000 (Hargrave et al. 2000) and in 2003 for the Custer National Forest (Kerschen et al. 2003).

A total of 458 possible sites were initially identified in or near the Gallatin National Forest. The majority of the abandoned and inactive mine sites were associated with the New World Mining District Response and Reclamation Project and the TVX Mineral Hill Mine at Jardine, which is considered active. Other possible sites could not be located or were not considered a safety or environmental hazard (Hargrave et al. 2000). Nine mine or mill sites were determined to have a potential to have adverse effects on soil or water quality to Gallatin National Forest administered lands.

A total of 78 possible abandoned and inactive mine sites were initially identified in or near the Custer National Forest. The majority of these sites were associated with the New World Mining District Response and Reclamation Project. Other possible sites could not be located or were not considered a safety or environmental hazard (Kerschen et al. 2003). Six mine or mill sites were determined to have a potential to have adverse effects on soil or water quality to Custer National Forest administered lands.

Using the information provided in these reports, Custer Gallatin staff conducted additional abandoned mine site inventories and site evaluations, which has resulted in the identification of additional safety hazards. Most notably, the Sioux District and the Pryor Mountains contain numerous uranium exploration attempts that are widely scattered throughout these areas. To date, hundreds of site disturbances associated with past exploration or mining activities have been identified and more may exist, as the inventory is ongoing.

Since the initial identification of these potential mine safety hazards, both national forests have prioritized work locations and implemented site specific reclamation actions. Depending upon the hazard, this typically entailed closing mine openings such as adits and shafts, with steel gates or foam plugs or removing hazards, regrading and revegetating previously disturbed sites. The restoration of uranium exploration attempts typically involves site recontouring and vegetation establishment.

Currently, neither the Custer nor Gallatin forests plans provide any degree of management direction related to abandoned mines or mining related hazards.

CERCLA Sites

The Comprehensive Environmental Response, Compensation, and Liability Act, (42 U.S.C. §9601 et seq. and 40 CFR part 300 et seq.(1980)), otherwise known as CERCLA or Superfund, provides a Federal "Superfund" to clean up uncontrolled or abandoned hazardous-waste sites as well as accidents, spills, and other emergency releases of pollutants and contaminants into the environment. CERCLA was enacted by Congress on December 11, 1980. This law created a tax on the chemical and petroleum industries and provided broad Federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment.

Generally, the Forest Service has CERCLA authority similar to the Environmental Protection Agency (EPA), although the Forest Service does not have access to the Superfund. Through CERCLA, the EPA and other Federal agencies such as the Forest Service or Bureau of Land Management generally attempt to identify the responsible party for any contamination before taking response actions themselves. Responsible parties can be any of the following: any generators of hazardous materials on location, transporters of hazardous materials to the site, and past or present site owners. Typically, responsible parties that have operated on national forest lands are mining as well as oil and gas interests. The responsible party has the option to willingly undertake the response task, but if they are unwilling, the responsible Federal agencies will order them to plan and implement a site cleanup. If they are somehow unable to do this or otherwise refuse to comply, the managing agency can then initiate the response and removal actions itself, paid for by a trust fund established specifically for this purpose.

Riley Pass CERCLA Site

Currently, the Custer Gallatin National Forest has one active CERCLA site, located on the Sioux District. The site, known as Riley Pass Abandoned Uranium Mine, is located on 250 acres of the North Cave Hills within the Sioux District. Riley Pass uranium mining started in 1954 as authorized by the General Mining Law and Public Law 357. Strip mining to reach uranium contained in the underlying Tertiary Fort Union formation coal resulted in the removal of up to 80 feet of overburden, which was piled on the outer edges of the rimrock or pushed off the bluffs into the adjacent draws. No reclamation was required or took place at the time of mining as directed by Public Law 357.

The site consists of twelve mined bluffs. In 1996, the Custer National Forest began working at the Riley Pass site under their CERCLA authority. The Forest Service and Office of General Council determined that Tronox, LLC (formally known as Kerr McGee or Kermac) was the potentially responsible party for site reclamation of 6 of the 12 Bluff mine sites. Tronox signed an Administrative Order on Consent (Settlement Agreement) for Bluffs B, C, D, E, G, and H. The remaining Non–Tronox bluffs have no viable potentially responsible party.

The Forest Service is presently in the process of designing and implementing long-term land restoration efforts at both Tronox and Non-Tronox bluffs abandoned mine sites. It is estimated that complete site restoration will require 20 or more years to effect the desired outcome.

New World Mine CERCLA Site

The New World Mining District is located in the general vicinity of Cooke City, Montana within the Beartooth Mountains portion of the Madison, Henrys Lake, Gallatin, Absaroka and Beartooth Mountains landscape area. The mining district encompasses the headwaters of three separate river drainages that include the Yellowstone, Clarks Fork of the Yellowstone, and the Stillwater Rivers. The lode-silver lead deposits of the New World mining district were discovered in 1869 and mining began there soon after. Numerous mines were developed in the area including the McLaren, Homestake, and Irma-Republic mines. From 1886 to 1953, the district produced gold, silver, copper, lead, and zinc (Hargrave et al. 2000).

The New World Mining District and subsequent CERCLA site includes a mixture of national forest and private lands near Cooke City Montana. This historic mining district contains hard rock mining wastes and acid discharges which have adversely effected the area since the cessation of mining. Human health and environmental issues were related to elevated levels of heavy metals present in mine waste piles, open pits and mine adits, acidic water discharging from mine openings, and stream sediments.

On August 12, 1996, the United States signed a Settlement Agreement with Crown Butte Mining, Inc. to purchase their interest in the historic mining district. This transfer of property to the U.S. government effectively ended Crown Butte Mining's proposed mine development plans and provided $22.5 million to cleanup historic mining impacts to certain properties in the district. In June 1998, a Consent Decree was signed by all interested parties and was approved by the United States District Court. The Consent Decree finalized the terms of the Agreement and made available the funds that will be used for mine cleanup. As specified in the Decree, monies available for cleanup will be first spent on the "District Properties" which include all property or interests in property that Crown Butte Mining, Inc. relinquished to the United States. After the District properties are cleaned up to the satisfaction of the United States, any remaining funds will be used to address other mining disturbances in the district.

Currently, the majority of contemplated restoration work has been successfully completed within the historic mining district. The area has been granted a waiver from the State of Montana water quality standards in recognition that the area was naturally and historically mineralized which naturally resulted in water quality conditions in exceedance of the State Water Quality standards. The Forest Service continues to monitor the site to determine if anticipated site function and environmental benefits within the district are taking place. As a result of the Settlement Agreement and associated locatable mineral withdrawal, the area is no longer available for mining and mineral activities. There is no term limit on the existing mineral withdrawal and thus, future mineral activities are not reasonably foreseeable in this area.

Potential CERCLA Sites

Currently, the Custer Gallatin National Forest has identified two abandoned mine sites within the bounds of the national forest that may represent potential CERCLA sites. One is located on the Sioux District, while another is located on the Bozeman District within the Madison, Henrys Lake, Gallatin, Absaroka and Beartooth Mountains landscape area. Although only two potential CERCLA sites are discussed below, it must be recognized that numerous potential CERCLA sites, associated with historic uranium exploration and mining are likely to exist within the Sioux District. At this time, the status of these sites as designated CERCLA properties is unknown pending further investigations and evaluations.

Lonesome Pete Abandoned Uranium Mine

A potential CERCLA site, known as the Lonesome Pete Abandoned Uranium Mine, is located within the South Cave Hills of the Sioux District. The site is located approximately 15 miles north of Buffalo, South Dakota. Locatable mining claims were first staked on the Lonesome Pete site on October 16, 1954. Through the years, interest and operating oversite of the property changed hands on numerous occasions. In 2008, the Custer National Forest prepared potentially responsible party assessment documentation as an initial step to begin CERCLA designation and ultimately, site restoration. At the time of the potentially responsible party search, no financially viable potentially responsible party was located. Currently, the Custer Gallatin is waiting for an Office of General Council response to the 2008 submitted potentially responsible party search. No restoration actions have been initiated at the site.

The 2003 Montana Bureau of Mines Report (Kerschen et al. 2003) summarizes this mine as differing from the uraniferous lignite ores found nearby. Seams and pockets of carbonaceous radioactive material were found in a 0.54-meter-thick dark gray, limy, sandy mudstone and not associated with lignite coals of the Fort Union Formation. Lonesome Pete No. 2 was one of the few mines that did not extract uranium from lignite. Curtiss (1955) states that the Lonesome Pete No. 2 was the largest mining operation in the area with 100,000 cubic yards of rock had been removed. Thus, a considerable amount of exploratory work was undertaken which yielded ore-grade materials when assayed. Currently, the site consists of a 15- to 20-foot high wall composed of a light gray siltstone capped by a brown sandstone. The upper mine bench is approximately 500 feet long and 150 feet wide, with 6 piles of gray silt sized material which likely represents residual ore left on site at the time of abandonment. These piles had higher radioactivity readings than the mine bench itself. Of the areas tested for radiation, three of the four sample locations were above the CERCLA criteria of three times radiation exposure as compared to background exposure levels. The locations which exceeded CERCLA criteria ranged from 5 to 366 times background radiation levels.

Karst Abandoned Asbestos Mine

The Karst Abandoned Asbestos Mine was first opened in 1901 by Gallatin Canyon pioneer Pete Karst. Mr. Karst sold his interest in the claims during the mid-1930s. Interstate Products in 1947, constructed a conveyer, dug a pit which eventually was sixty feet deep and 90 feet across, built a mill near the Gallatin River, and opened a road from the mine to the highway. It ran sporadically through the World War II era, according to a 2001 assessment of the site prepared for the Forest Service by MCS Environmental Inc.

The Custer Gallatin has managed the situation and reduced public exposure potential by rerouting a national forest trail that led directly to the open pit asbestos mine site. The site is being naturally revegetated, which is intended to render any asbestos that may be contained in the area unavailable for human exposure. The Custer Gallatin has determined that any attempt to physically close and restore the area through use of heavy equipment could release more asbestos minerals into the air.

Current Type Extent and General Locations of Mineral and Energy Activity and Energy Facilities

Federal Locatable Minerals

Locatable minerals include both metallic minerals (gold, silver, copper, zinc, nickel, lead, and platinum) and nonmetallic minerals (fluorspar, asbestos, gypsum, mica, locatable grade limestone, and pumice) and certain uncommon variety minerals. Pursuant to the General Mining Law of 1872, every U.S. citizen is guaranteed the right to prospect and explore lands reserved from the public domain open to mineral entry. The right of access for exploration and development of locatable minerals is also guaranteed, although the Forest Service may condition this right.

If the land within the planning area is open to mineral entry and a mining claim is properly filed with the BLM and the local county, the claimant has legal title to the mineral. The BLM’s mining claim database, LR 2000, lists active (current) and closed mining claims recorded on public lands. The status of mining claims can change on an annual basis and new claims can be recorded at any time throughout the year. It is common for an entity to hold a mining claim or claims without undertaking exploration or mining activities. Thus, a specific listing of all current mining claims within the boundary of the Custer Gallatin

National Forest will not be presented here since mining claims will change over the life of the ensuing forest plan. A broader discussion of mineral activity areas within the Custer Gallatin National Forest will provide more useful information in terms of describing current and future locatable mineral trends.

Locatable Mineral Activities on the Custer Gallatin

Currently, there are numerous authorized locatable mineral activities, such as exploration or production operations for locatable minerals within the boundaries of the planning area. Approved locatable mineral operations range in scope from large underground mines (Stillwater Mining Company) to very small dredging and hardrock exploration programs. Between 1995 and 2015, the Custer Gallatin has processed and administered 5 to 10 plans of operations and/or notices of intent annually. The majority of these activities have occurred within the Stillwater Complex, within the Yellowstone and Beartooth Districts. Typical mitigations and resource protections that are included with these approved plans include requirements addressing water quality, water quality, wildlife and fisheries, cultural resources, reclamation practices, and social or forest user implications. Assignment and approval of these environmental and social mitigations are in conformance with both the current Custer and Gallatin forest plans, which call for all such mineral plans of operations to undergo an environmental evaluation process and ultimately to minimize effects to the human environment. To date, these prescribed and implemented mitigations have largely precluded violation of Federal or State statutes pertaining to these resource values.

Placer Mining

Historical placer prospecting and exploration activities have occurred across the planning area. Commercially viable placer exploration, development and mining properties have typically been associated with geologic environments consisting of intrusive and extrusive igneous rocks (volcanics, stocks, and dikes) within the Emigrant, Mill Creek and the Tom Miner Basin portions of the Custer Gallatin. Large-scale dredges were employed adjacent to portions of the planning area. Recent interest in placer exploration has been taking place within the Emigrant Creek and the Gardiner/Jardine areas. Other small scale placer activity is ongoing in the Boulder River drainage.

Hardrock Mining

The Custer Gallatin National Forest currently hosts two large-scale hardrock mining enterprises, both of which are located within the Stillwater Complex along the northern margins of the Beartooth Plateau. Both of these mines produce platinum and palladium minerals and are operated by the Stillwater Mining Company. These two mines represent a significant direct source of employment within and adjacent to the planning area. The scale and grade of the ore deposit suggest that at a minimum mining activities should continue throughout the forest planning horizon and possibly in excess of 30 years.

Locatable mineral mining or exploration attempts are proposed or ongoing in areas within and immediately adjacent to the Custer Gallatin National Forest. Most notable are exploration activities within the Crevice/Jardine and Emigrant areas, as well as ongoing locatable grade limestone mining adjacent to the Pryor Mountains. As previously indicated, plans of operations pertaining to exploration across the 28-mile exposure of the Stillwater Complex are annually processed.

Federal Leasable Mineral and Energy Resources

Leasable mineral commodities include oil, gas, coal, geothermal, potassium, sodium phosphates, oil shale, sulfur, and solid leasable minerals on acquired lands. Leasable public domain minerals are leased under authority of the Mineral Leasing Act of 1920, as amended. Acquired minerals are leased under the authority of the 1947 Mineral Leasing Act for Acquired Lands (1947 Act), as amended. The BLM issues all leases for the production of federally owned oil and gas with consent of the Forest Service.

Prior to the Federal Onshore Oil and Gas Leasing Reform Act of 1987, the Forest Service's authority regarding oil and gas leases issued on National Forest System lands was varied, and in many cases the Forest Service only made non-binding recommendations to the BLM. The 1947 Act requires Forest Service consent prior to the leasing of an acquired mineral estate in the National Forest System lands. Under the 1987 Leasing Reform Act, the Forest Service's decision to lease with certain stipulations, or not to lease, is binding with the BLM for oil and gas resources on National Forest System lands. Forest Service regulations at 36 CFR 228 Subpart E, (issued in April 1990) establishes the process for making oil and gas leasing decisions in accordance with the Leasing Reform Act.

Under the Federal Coal Leasing Amendments Act of 1975, Forest Service consent is required for a coal license or lease. Whether reserved from public domain or acquired lands, pursuant to the Geothermal Steam Act of 1970, BLM may lease geothermal resources after obtaining consent from the Forest Service.

Leasable Mineral Activities, Existing Leases, and Lease Nominations on the Custer Gallatin

Currently, the Custer Gallatin National Forest has 88 authorized leases totaling 118,601.8 acres. Approximately 100,531.4 of these leased acres are located on the Gallatin portion of the national forest, but they have been suspended from further activities, as a result of legal challenges as discussed below. The remaining 18,070 acres of authorized leases are located on the Sioux District (16,063.5 acres) and the Beartooth District (2,007 acres).

The Sioux District contains three existing oil and gas wells. One is a saltwater disposal well while the other two produce oil and gas resources. At this time, there is no leasable mineral exploration activity on the Custer Gallatin National Forest.

The majority of the planning area does not have a current oil and gas leasing analysis necessary to offer leasable mineral resources for lease sale. Only the South Dakota portion of the Sioux District currently has an Oil and Gas Leasing environmental impact statement and associated record of decision. As a result, all portions of the South Cave Hills were leased in January 2009. To date, no applications for development have been received. Given the current projection of oil and gas prices, little interest in leasing is anticipated for the near future. If payable quantities of leasable mineral resources have not been established 10 years after lease sale, the parcels will revert back into Federal ownership.

A conventional oil and gas leasing environmental impact statement was previously conducted and approved for the Beartooth Mountain unit of the Beartooth Ranger District in 1993. The 1987 Custer forest plan was amended to incorporate decisions made in this site-specific analysis. However, given the date when the Beartooth Oil and Gas Leasing Decision was made, and the advancements in oil and gas completion and production technology that has taken place since 1993, it is doubtful that a site specific exploration attempt could be successfully implemented through guidance contained in the 1993 Beartooth Leasing Environmental Impact Statement.

The Custer Gallatin National Forest also has a number of pending lease parcels. Pending parcels are those areas which have been nominated for lease sale by the oil and gas industry, but no leasing action has taken place. The Ashland District has 13 pending parcels nominations totaling 19,056.6 acres. Most of these leases nominations were filed at the time when coalbed methane leasing, exploration, and development was taking place immediately south and east of the district. It is presumed that these pending lease nominations are associated with possible coalbed methane occurrence within the Fort Union coals located within the Ashland District. Since that time, the coalbed methane industry has experienced a significant downturn in exploration, development, and production activities.

The Beartooth District has seven pending leases nominations totaling 6,481 acres.

The Northern Region of the Forest Service priorities for oil and gas leasing environmental impact statements are based on available funding for analysis, public desire for action, and/or applications for permits to drill on existing leases. At the present time, all of these factors suggest that an oil and gas leasing decision is not pressing on the Custer Gallatin National Forest. There are no current plans to initiate an environmental impact statement.

Suspended Oil and Gas Lease Activities on the Custer Gallatin

The Secretary of Interior, through the BLM, suspended certain oil and gas leases that had previously been sold in 1985 as a result of the *Conner v. Burford* district court decision [*Conner v. Burford*, 605 F. Supp. 107 (D.Mont.1985)]. The court found the environmental “effects analysis” supporting lease issuance on the Gallatin and Flathead National Forests to be inadequate. The court specified that no activity may take place on the leases until an environmental impact statement is completed. The 9th Circuit Court of Appeals upheld the district court decision to require an environmental impact statement prior to any post-leasing activities in a January 13, 1988 decision, as amended July 1, 1988. Until the lease suspension issue is resolved, no oil and gas exploration drilling can be undertaken on the leases subject to the Court of Appeals decision on the *Conner v. Burford* case.

As of April 4, 2016, 68 suspended oil and gas leases covering 100,531.4 acres are located within Custer Gallatin National Forest lands. These suspended leases are found within the Madison, Henrys Lake, Gallatin, Absaroka and Beartooth Mountains landscape area on the Bozeman (51 leases; 77,203 acres), Gardiner (1 lease; 480 acres), and Livingston (16 leases; 22,848.3 acres) Districts (Deuter 2016, pers. comm.).

Coal Energy Resources on the Custer Gallatin

Significant coal deposits are found within the Powder River Basin of southeastern Montana. The Ashland District is located within this area. The Powder River Basin contains the largest occurrence of low-sulfur, low-ash, subbituminous coal in the United States and is the single most important coal basin in the United States. Much of this coal resource is associated with the Tongue River Member of the Fort Union Formation.

The Ashland District and to a lesser degree, the Sioux District contain much of the coal resource found on the Custer Gallatin National Forest. Coal deposits of the Ashland District are best described as sub-bituminous while coal within the Sioux District is classified as lignite. Surface mining of coal resources within the bounds of the Ashland District are currently precluded from surface mining through enactment of the Surface Mining Control and Reclamation Act (SMCRA) of 1977. The provisions of Act do not address underground coal mining or the development of coal bed methane energy resources. No expressed interest in leasing of coal within the Ashland District has been received. Similarly, no interest in leasing or development of lignite coals of the Sioux District has been expressed owing to its associated uranium content and low grade fuel value. Given the current price and coal market conditions, future coal development is not foreseeable.

Coalbed Methane Energy Resources on the Forest

A number of Bureau of Land Management assessments related to coalbed methane occurrence and development potential have been conducted for lands encompassed within the planning area. These include the Montana Statewide Oil and Gas EIS and Amendment for the Powder River and Billings Resource Management Plans (USDI BLM 2003). This analysis was later amended via the 2008 Supplement to the Montana Statewide Oil and Gas EIS and Amendment of the Powder River and Billings Resource Management Plans (USDI BLM 2008a). Areas that were identified as having a high occurrence and development potential were generally located within the Ashland District, within the Powder River Basin of southeastern Montana. Areas that were identified as having a high to moderate occurrence and development potential related to coalbed methane include the Bangtails and northern portions of the Absaroka Mountain areas due to the occurrence of Cretaceous aged coals of sufficient thickness.

Based on direct evidence, significant amounts of coalbed methane energy resources may exist within the Ashland District. The retention of coalbed methane within coals found on the Ashland District is complicated by the degree of erosion and dissection of these coals. Much of the coalbed methane that has been generated in these coals may have been lost to horizontal migration through the coals into the environment. Although leases within the district have been nominated, no leasing has occurred. Since the time of the expressed interest in leasing, the coalbed methane industry has declined significantly due to more cost effective sources of natural gas production associated with shale gas recovery. Requests for leasing of possible coalbed methane resources within the Custer Gallatin National Forest including the Ashland District are not foreseen at this time.

The 2008 BLM Statewide Oil and Gas Leasing Environmental Impact Statement (USDI BLM 2008) considered lands within Gallatin and Park Counties by the Bureau of Land Management and the Montana Board of Oil and Gas Conservation. Areas along the I-90 corridor are known to contain coal deposits capable of supporting coalbed methane development. The area, which included both private and Federal lands, was identified as having moderate occurrence and development potential related to coalbed methane resources.

Two locations were previously permitted for exploration drill holes for coal bed natural gas on untested private land in the Trail Creek coal field by the state of Montana in 2001. This area is generally located south of Interstate 90 and slightly east of the Custer Gallatin National Forest boundary. Legal challenges involving Gallatin County and the formation of a local zoning district tied up the drilling process and the permits to drill expired in January of 2003. It is unknown whether this potential coalbed methane resource may be located under lands managed by the Custer Gallatin National Forest. To date, no expressed interest in leasing and subsequent exploration has been forthcoming to the Custer Gallatin National Forest.

Coalbed resource exploration within Park County was initiated in 2007 and resulted in a four well drilling program in northern Park County. None of the locations were located on Federal lands or attempted to access Federal minerals. No commercial production was established.

Energy Facilities on the Custer Gallatin

Two renewable energy facilities are located within the Custer Gallatin National Forest. The Mystic Lake hydroelectric dam, located on the West Rosebud River, Beartooth District, has been in operation since 1924. Mystic Lake Dam is a two-unit hydroelectric plant and is classified as a “storage generation” project because it uses the water stored in its reservoir to generate electricity. Mystic Lake Dam is permitted by the Federal Energy Regulatory Commission through 2050. Upgrades to the original turbines enable the facility to generate up to 11.8 megawatts.

Hebgen Lake, located on the Hebgen Lake District within the Madison, Henrys Lake, Gallatin, Absaroka and Beartooth Mountains landscape area, serves as a storage reservoir, which provides water release from a 905-square-mile drainage area at the headwaters of the Madison-Missouri river system. These water releases, flows into eight downstream Montana hydroelectric plants. While operation of Hebgen Lake dam is used to regulate the flow of water into the Madison-Missouri system, it does not specifically generate hydropower.

Orders issuing preliminary permits were recently granted by the Federal Energy Regulatory Commission to study hydropower project feasibility on East Rosebud and West Rosebud Creeks on the Beartooth Ranger District and Quake Lake Reservoir on the Hebgen Ranger District (FERC 2016). While these permits for feasibility studies were issued by the Commission, no special use permit applications for such studies have been received by the Forest Service to date. There are no other known, pending or proposed hydroelectric permits, projects, dams or storage reservoirs on the Custer Gallatin.

Federal Salable Minerals

Salable minerals, such as common varieties of sand, stone, gravel, cinders, clay, and pumicite that are reserved from the public domain fall under the Materials Act of 1947. The associated Forest Service regulations at 36 CFR 228, Subpart C provide for disposal of mineral material on public lands through competitive sale, negotiated contracts, free use and Forest Service internal staff or contract (36 CFR 228.57). The salable mineral material policy, as specified in Forest Service Manual 2850-3, states that disposal of mineral material will occur only when the authorized officer determines that the disposal is not detrimental to the public interest and that the benefits to be derived from a proposed disposal would exceed the total cost and impacts of resource disturbance.

The Custer Gallatin uses mineral materials, such as gravel, riprap, and crushed aggregate in routine management, maintenance and/or new construction of roads, recreation sites and trailheads. Other uses may include contract work, culvert replacement, and repair of damage caused by fire, floods, landslides and abandoned mine reclamation. The mineral material used by the Custer Gallatin is partially derived from Forest Service pits and quarries located in the planning area. Table 2 and Table 3 identify the type and locations of various mineral materials utilized for these types of management actions across the Custer Gallatin National Forest.

Table 2. Active Mineral Material Pits; Bozeman, Gardiner, Yellowstone and Hebgen Districts

Legal Location	Pit Name	Type of Mineral Material	Comment	District
T9S, R9E, NW1/4 Section 7	Eagle Creek	pit run sand and gravel	NRM# GAR-003	Gardiner
T9S, R15E, SW1/4 Section 20	Cooke City HWY Pit	crushed gravel & rip rap	NRM# GAR-006	Gardiner
T5S, R12E, NE1/4 Section 13	Miller Creek Pit	pit run sand and gravel	None Listed	Yellowstone
T5N; R10E; NE1/4 Section 35	Sunlight Pit	pit run sand and gravel	NRM# LIV-002-13-3	Yellowstone
T6S, R10E, NW1/4 Section 29	Mill Creek East Dam	gravel	NRM# LIV-002	Yellowstone
T6S; R4E; NW1/4 Section 13	Portal Creek	rip rap	NRM# BOZ-001	Bozeman
T5S, R4E, NW1/4 Section15	HWY 191 Pit	rip rap	NRM# BOZ-006	Bozeman

Legal Location	Pit Name	Type of Mineral Material	Comment	District
T3S, R5E, Section 25	Hyalite	rip rap, sand and gravel	NRM# BOZ-009	Bozeman
T9S, R4E, NW1/4 Section 11	Taylor Fork	pit run sand and gravel	NRM# HEB-007-03	Hebgen
T11S, R3E, SE1/4 Section 16	Beaver Creek	pit run gravel	NRM# HEB-007-02	Hebgen
T11S, R2E, SW1/4 Section 36	Quake Lake	rip rap and boulders	NRM# HEB-007-11	Hebgen
T12S, R5E, NE1/4 Section 17	Grayling Pit	pit run sand and gravel	NRM# HEB-007-17	Hebgen

Table 3. Active Mineral Material Pits; Ashland and Sioux Districts

Legal Location	Pit Name	Type of Mineral Material	Comment	District
T3S, R47E, SESW Section 23	Camps Pass Scoria Pit	Scoria	Archeological Report D4-90-05 on Record	Ashland
T3S, R47E, NWNW Section 33	No Name	Scoria	No Record of Heritage Inventory	Ashland
T4S, R47E, SWNW Section 31 (actually two pits in the W½ 31)	Tenmile Creek	Scoria	Archeological Report D4-84-01 on Record	Ashland
T4S, R47E, N½SW Section 31	No Name	Scoria	Archeological Report D4-84-01 on Record	Ashland
T5S, R47E, NWNW Section 21	No Name	Scoria	No record of Heritage inventory	Ashland
T6S, R44E, SW Section 7	No Name	Scoria	Archeological Report D4-85-06 on Record	Ashland
T6S, R44E, NESE Section 21	No Name	Scoria	No record of Heritage inventory	Ashland
T6S, R44E, SWNE Section 9	Location #3	Scoria	Archeological Report D4-81-38	Ashland
T6S, R44E, NWNW Section 10	Location #2	Scoria	Archeological Report D4-81-38	Ashland
T6S, R44E, NESE Section 23	Survey Area #4	Scoria	Archeological Report D4-88-05	Ashland
T6S, R45E, SENW Section 18	Location #1	Scoria	Archeological Report D4-81-38	Ashland
T6S, R45E, SESE Section 18	Cow Creek Pit #2	Scoria	Archeological Report D4-01-02	Ashland
T6S, R45E, SESE Section 22	Cow Creek Pit	Scoria	Archeological Report D4-88-05	Ashland
T6S, R45E, NESE 2 Section 2	Survey Area #2	Scoria	Archeological Report D4-88-05	Ashland
T7S, R45E, SWSE Section 20	No Name	Scoria	No record of Heritage inventory	Ashland
T7S, R46E, SESW 2 Section 9	Reanus Quarry	Scoria	Archeological Report D4-87-17	Ashland

Legal Location	Pit Name	Type of Mineral Material	Comment	District
T7S, R47E, center Section 20	Powder River County Gravel Pit	Scoria	Archeological Survey conducted 1978	Ashland
T2S, R46E, Sections 1 & 12	No Name	Scoria	Archeological Report D4-87-05	Ashland
T2S, R47E, NE Section 19	Little Pumpkin Creek	Scoria	Archeological Report D4-84-01	Ashland
T4S, R45E, W½SE Section 21	Drop Tube Quarries	Scoria	Archeological Report D4-88-18	Ashland
T4S, R47E, center of Section W½ 7	No Name	Scoria	Archeological Report D4-14-09	Ashland
T5S, R43E, SESE Section 12 and T5S, R44E, SW Section 7	Survey Area #5	Scoria	Archeological Report D4-88-05	Ashland
T6S, R44E, SWSW 3 and SESE Section 4 and NENE Section 9 and NWNW Section 10	Hay-Stocker Gravel Pit Re-entry	Scoria	Archeological Report D4-13-12	Ashland
T6S, R44E, SWNW Section 2 and SENE Section 3	Stocker Branch Pit	Scoria	Archeological Report D4-01-07	Ashland
T6S, R44E, SWSW Section 7	Timber Creek Pit	Scoria	Archeological Report D4-85-06	Ashland
T6S, R44E, SESE Section 18 and NENE Section 19 and NWNW Section 20	Survey Area #3	Scoria	Archeological Report D4-88-05	Ashland
T6S, R45E, SWSE Section 7 and NWNE Section 18	O'Dell Pit	Scoria	Archeological Report D4-01-07	Ashland
T6S, R45E, center of E½ Section 22	Survey Area #2	Scoria	Archeological Report D4-88-05	Ashland
T1S, R46E, NENE Section 3	1970s-era scoria pit re-entry	Scoria	Archeological Report D4-12-07	Ashland
T22N, R5E, Sec Section 19	Craig Pass Pit	Pit Run Aggregate	Archeological Reports D3-98-06 And D3-02-13	Sioux
T22N, R5E, NW Section 19	North Cave Hills Quarry	Scoria	Archeological Report D3-88-02	Sioux

No active in-service mineral materials pits are located on the Beartooth District. However, the district does annually issue in excess of 25 personal use mineral material permits. These permits are typically associated with nonmechanized removal of common variety glacial cobbles used for decorative and landscaping purposes. Other administrative units (ranger districts) also issue personal use mineral material permits.

Renewable Energy Resources

In 2013, the National Renewable Energy Laboratory (NREL) completed an assessment of the potential for solar and wind energy development on National Forest System lands entitled "Analysis of Renewable

Energy Potential on U.S. National Forest Lands" (Zvolanek et al. 2013). Much of the information presented here relative to renewable energy potential is drawn from that information. Authorization and permitting of both wind and solar renewable energy activities are considered as special uses by the Forest Service. Management direction and authority for these actions is provided by the Federal Land Policy and Management Act of 1977 (FLPMA). Section 501(a) (4) of FLPMA, 43 U.S.C. 1761(a) (4) (FSM 2701.1, para. 15) authorizes the Forest Service to issue rights-of-way authorization for the use and occupancy of National Forest System lands for generation, transmission, and distribution of electric energy. Additionally, the Energy Policy Act of 2005 (section 211) recognizes the Forest Service's role in meeting the renewable energy goals of the United States. Consistent with Agency policies and procedures, the use and occupancy of National Forest System lands for alternative energy production, such as solar and wind energy development, are appropriate and will help meet the energy needs of the United States. An authorization for construction and operation of a commercial solar or wind energy facility may be issued for up to 30 years.

Wind Power

National Forest System lands were evaluated for potential suitability for wind energy development (Zvolanek et al. 2013). Montana and western South Dakota have substantial potential for wind generation. As documented in the 2013 Argonne National Laboratory study of National Forest System lands, units most suitable for wind power are concentrated in the northern Great Plains. The planning area was found to have potential for the development of wind energy due to the available resource and proximity to transmission lines (US Department of Energy NREL 2005).

Nationwide, lands managed by the Custer National Forest were identified as one of the top 10 national forest units with the most potentially suitable land for wind development, with 139,243 acres which could produce 2,785 megawatts of wind generated energy (assuming 50 acres per megawatt). The lands within the Gallatin National Forest portion of the planning area were estimated to have 3,678 acres of potentially suitable land for wind development which could potentially generate 75 megawatt of wind generated energy (assuming 50 acres per megawatt).

Solar Power

The plan area was not found to have a high potential for the development of solar energy (U.S. Department of Energy NREL 2005 and Zvolanek et al. 2013). The Custer National Forest maximum development potential for photovoltaic solar energy is 69,929 acres with potential to generate 1,415 megawatts of energy (assuming 1 megawatt per 5 acres). Custer National Forest estimates are also displayed by state, with 38,557 acres with potential to generate 780 megawatts of energy in Montana and 31,372 acres with potential to generate 635 megawatts of energy in South Dakota. The Gallatin National Forest is estimated to have 49,410 acres of maximum development potential for photovoltaic solar energy with 1,000 megawatts (assuming 1 megawatt per 5 acres).

Hydropower

Hydropower accounts for 36 percent of electricity generation in Montana and 40 percent in South Dakota (National Hydropower Association 2016). The permitting and licensing of hydropower projects is overseen by the Federal Energy Regulatory Commission. Because the construction and operation of hydropower facilities hold significant implications for the environmental, cultural, and economic resources in a river system, projects undergo a rigorous review with input from stakeholders including Federal and State resource management agencies. Hydropower siting considerations include impacts to fish and wildlife, water quality, dam safety, historical resources, and even recreational resources.

The western, more mountainous portions of the Custer Gallatin have the highest potential for hydropower development and generation due to topographic characteristics of the terrain. Additionally, these areas typically receive a relatively constant input of precipitation as compared to prairie ecosystems located in the eastern portions of the Forest. The eastern portions of the Custer Gallatin have limited localized opportunities for the further development of hydropower energy generation.

As evidenced by the recent proposal for hydropower development in the East and West Rosebud drainages, located on the Beartooth District within the Madison, Henrys Lake, Gallatin, Absaroka and Beartooth Mountains landscape area, significant local opposition to these types of development proposals are likely to take place.

Geothermal Potential

In general, geothermal systems and resources vary from high temperature steam located near the earth's surface, to waters being pumped from a down gradient drill-hole which have been warmed due to a natural hydrothermal gradient within the earth's crust. Most places within the earth's crust warm up approximately 14 degrees Fahrenheit for every 1,000 feet (304.8 meters) of depth. An attractive geothermal resource may exist where the geothermal gradient is significantly higher than 14 degrees Fahrenheit for every 1,000 feet (Heasler 1985). Geothermal resources are defined as all products of geothermal processes including indigenous steam, hot water or hot brines, steam and other gases, heat or other associated energy found in geothermal formations, and any byproducts (43CFR 3200). Renewable energy minerals on Federal lands, including National Forest System lands, are made available through issuance of leases similar to nonrenewable energy resources.

A nationwide Programmatic Final Environmental Impact Statement for Geothermal Leasing in the Western United States was prepared that identified lands that would be made available for issuance of geothermal leases. Subsequently, a Record of Decision was issued by the BLM and the Forest Service in 2008 (USDI, USDA 2008). The analysis identified National Forest System lands that are legally open or closed to geothermal leasing in 12 western states, including the Montana portions of the Custer Gallatin National Forest. The South Dakota portion of the planning area was not considered in this effort.

Certain lands within a planning area may be excluded from geothermal leasing on the basis of existing laws, regulations (see 43 CFR 3201.11) and Executive Orders. These non-discretionary closures are typically associated with designations of national monuments, wilderness areas, some wilderness study areas, and designated wild rivers under the Wild and Scenic River Act. Since the South Dakota portion of the Custer Gallatin National Forest was not considered within the Programmatic Final Environmental Impact Statement for Geothermal Leasing, a separate geothermal leasing environmental impact statement would need to be conducted prior to leasing or development.

National Forest System units were evaluated for enhanced geothermal systems (Zvolanek et al. 2013). Neither the Custer nor Gallatin National Forests were in the list of top 10 national forests with the most potentially highly suitable land for enhanced geothermal systems development. Results specific to the Custer Gallatin National Forest are:

- The Custer National Forest was identified as having potential of 354,596 medium suitability acres, 11,985 medium-high suitability acres, and 9,946 high suitability acres. The Gallatin National Forest was identified as having potential of 33,236 Low Suitability Acre, 18,471 Medium-Low Suitability Acres, 30,888 Medium Suitability Acres, 1,174 Medium-High Suitability Acres, and 0 High Suitability Acres

- Most of the lands which are attractive from a geothermal perspective are associated with known hot springs located within the Madison, Henrys Lake, Gallatin, Absaroka and Beartooth Mountains landscape area or elevated water temperatures at depth in the far eastern portions of the planning area within the Ashland and Sioux Districts.

Key Benefits to People

Historic exploration and development of the planning area was largely driven by the quest for mineral resources during the mid- to late 1800s and continues today. The exploration, development, and mining of mineral resources within the Custer Gallatin National Forest provides significant employment to local and regional residents. Direct employment associated with both of Stillwater Mining Company's operating platinum and palladium mines is reported as ranging from 1,300 to 1,600 employees or subcontractors. Effects to indirect employment is typically projected at three times more than direct hires. More broadly, utilization of minerals produced on the Forest serves to benefit the national clean air interest through the use of palladium in the automotive industry.

Risks and stressors associated with the continued mining of mineral resources located on the national forest are related to global economic forces, commodity prices, and the need or desire of society at large to produce and use these products.

The planning area additionally provides benefits to people and contributes to the quality of life within and surrounding the planning area due to the scenic wonders associated with mountains, alpine landscapes, and prairie vistas. The geologic conditions currently present within the Custer Gallatin provide reliable clean water necessary to support a variety of lifestyles and interest. Topographic diversity in both montane and prairie ecosystems provide a diversity of habitats used by both flora and fauna within the area. The richness of the landscape is typically directly influenced by geologic process that shaped it. Appreciation and use of these unique landscapes through recreational activities has increased during the last decade and are expected to continue to increase in the future. The surrounding local economies benefit as a result of this increased recreational use of national forest lands.

Mineral materials from quarries and pits located on the Custer Gallatin are used to maintain existing roads as well as in the construction and maintenance of new roads, develop recreation sites, trail heads and other facilities. Access and parking for hunting, outfitting, camping, and other recreation activities is a critical component of public use and enjoyment of the public lands. Without passable roads, the national forest would not be accessible to the public, Custer Gallatin staff, and national forest contractors.

Risks and stressors to the continued use and enjoyment by the public will largely be influenced by the availability of these geologic attributes in their current form and cost associated with accessing and utilizing or experiencing the desired recreational and educational activities.

Trends and Drivers

Trends that affect energy and mineral activity include economics, national and local politics, environmental policies, public perspectives of environmental impacts, cultural shifts toward sustainable energy resources, such as water and wind energy; laws and legal decisions; and national and international supply and demand for natural resources. All of these factors have and continue to change through time and appear to be highly unpredictable.

Locatable Activities

The future prospects for placer exploration and mining are related to the price of metals, accessibility of drainages that host this geologic occurrence, environmental requirements related to surface resource management, and changes in technology used to extract minerals. Generally, most of the drainages with historic gold placers have been claimed and worked by one or more eras of activity in response to changes in exploration and mining technology. Between the years 2008 and 2013, the price of gold was extremely high but it did not result in a substantial increase in proposed placer activities on the Custer Gallatin National Forest.

The price of gold may not be a primary driving factor in new placer projects. Most of the recent interest expressed is associated with hobbyist level activities. Most historic placer drainages have patented mining claims. Access to these lands for mining would need to be by landowner permission and would require various State and Federal permits. Another deterrent may be the difficulty and cost in securing permits through the various regulatory agencies. The potential for a large, unworked, profitable mineral bearing gravel resource appears to be unlikely.

Over the past 25 to 30 years, located mining claims across the Custer Gallatin National Forest have not significantly varied in numbers. Areas with significant mineralization have been identified, explored, and mined in excess of 100 years. These areas are and generally have been claimed for the presence of locatable minerals during that time span. Another factor that affected the number of located mining claims is mining claim rule changes and increases in fees charged by the Bureau of Land Management and counties for filing and recordation of mining claims. This has resulted in a reduced number of mining claims since the year 2000. Small-scale lode and placer prospecting and exploration attempts are anticipated to be cyclic in the future in response to commodity prices, societal demand for resources, and technologic advancements.

Looking towards the future, mining activities within the Stillwater Complex are expected to continue over the next 30 to 50 years as influenced by production capacity, ore availability, commodity prices, and societal demand for produced mineral resources. Current combined production at both platinum and palladium mines operated by the Stillwater Mining Company exceed 4,000 tons per day. This degree of platinum and palladium ore production is anticipated to continue or increase over the life of the forest planning effort.

It must be noted that there are known locatable minerals located is areas immediately adjacent to the Custer Gallatin National Forest. These areas include Emigrant Creek area, Crevice Jardine area, and Pryor Mountains. Although exploration or production activities are currently confined to private lands in these areas, it is conceivable that the mineral resources being sought occur within the adjacent National Forest administered lands. As long as the adjacent National Forest System Lands are open to mineral entry, future proposal on National Forest System lands are possible.

The 2005 U.S. Geological Survey mineral and energy resource assessment of the Gallatin National Forest, exclusive of the Absaroka-Beartooth study area, found that two previously unexplored significant locatable mineral resources occur within the bounds of the national forest. These deposits are known as the Pass Creek lead-zinc-silver-gold deposit in the Bridger Range and the Half Moon lead-copper-silver-gold deposit in the Crazy Mountains. Neither has been developed. The 2005 U.S. Geological Survey report concluded that future locatable mineral production in these areas are unlikely due to unknown economic values and cost associated with mineral extraction, transportation and refinement. In addition, substantial public concern in regards to locatable mineral extraction within the Greater Yellowstone Ecosystem could serve to reduce the possibility of future mining activities.

Additional mineral assessments have been conducted by the U.S. Geological Survey across the more than 3 million acres of the current Custer Gallatin National Forest. The Absaroka-Beartooth study area, which is located directly north of Yellowstone National Park and east of the Yellowstone River, was identified as the portion of the Custer Gallatin most likely to host future locatable mineral actions. All of the current metallic mineral production and most of the recent exploration activity in the national forest are concentrated in the Absaroka-Beartooth study area. It is estimated that the bulk of future locatable mineral prospecting, exploration, or production within the bounds of the Custer Gallatin National Forest would occur in this area. The U.S. Geological Survey (2005 and 2007) has identified a potential for the occurrence of undiscovered porphyry deposits on the Gallatin near the northwest corner of Yellowstone in the Emigrant Gulch/Crevice area. However, the Headwaters Province report pertaining to Idaho and Montana (USGS 2007) indicated that for a variety of reasons principally, economic, environmental, and social tolerance, it is not reasonably foreseeable that future locatable minerals discovery in this area would be developed to a production phase.

In areas of the Custer Gallatin further to the east, the U.S. Geological Survey conducted separate studies pertaining to the Pryor Mountains of south-central Montana (Van Gosen and others 1996). The possibility of metallic mineral activities within the Pryor Mountains was rated as low (Van Gosen and others 1996), although the continued extraction of locatable grade limestone is reasonably foreseeable. Additionally, the Ashland and Sioux Districts, which represent the eastern most extension of the national forest were found to have a low potential for locatable mineral occurrence or development. This fact is directly related to the geologic environment and conditions within and adjacent to these eastern most districts. Essentially, both districts are composed of sedimentary rock units which do not contain locatable metals (USGS 2005).

Finally, it must be noted that the potential exists for the discovery and exploration as well as the possible mining of a previously unforeseen mineral deposits within the bounds of the Custer Gallatin National Forest on lands open to mineral entry.

Leasable Mineral and Energy Resources

Trends and drivers which influence the exploration and development of leasable mineral resources in the planning area are dependent upon many factors; including, but not limited to, land status (i.e., outstanding mineral interest), court mandates, exploration costs, quantity and economics of existing and projected reserves worldwide, political climate, and future world demand and prices. Regulatory policy related to carbon emissions also influence the exploration and development of leasable mineral resources nationally and internationally.

The forecasts of potential leasable mineral activity are based on “reasonably foreseeable development scenarios” prepared by the BLM for their resources management plan revision efforts (Glover and Stillwell 2014). The scenario is an analysis of the known and potential oil, gas, and coal resources within the plan area (occurrence). A projection of the magnitude and trend of future leasable activity within the planning horizon (development potential) is also provided. Reasonably foreseeable development scenarios are prepared by agency geologists using a variety of research information, leasing statistics, and geologic data in consultation with local and State experts. Data provided by industry is also considered.

Areas evaluated in reasonably foreseeable development scenarios are typically designated as having high, moderate, low, and very low potential for the occurrence and development of oil and gas resources. High occurrence potential areas occur only within proven producing petroleum provinces or in areas with a significant number of hydrocarbon “shows.” Areas of moderate occurrence potential have a significant thickness of sedimentary rocks capable of acting as petroleum sources and reservoirs. An area having a low potential for occurrence has a thin sedimentary section present or there is insufficient subsurface data available to analyze the potential. It also lacks source or reservoir rocks or is metamorphosed. An area of very low occurrence potential has no sedimentary section at the surface or insufficient data for a different classification (USDI BLM 2009). These areas are often associated with igneous and metamorphic geologic environments. A particular areas' development potential is directly related to ease of access, as well as the cost of drilling, completion and production. Areas of high development potential can quickly become areas of low to moderate development potential due to economic and market forces.

As previously indicated, the planning area stretches across approximately 400 miles of southern Montana and northwest South Dakota. This area contains divergently differing geologic conditions characterized by mountainous terrain in the western and central portions of the planning area, which have significant occurrences of igneous and metamorphic rocks. The eastern portions (Ashland and Sioux Districts) are characterized by relatively flat lying sedimentary geologic units.

A number of Bureau of Land Management and/or Forest Service assessments have considered reasonably foreseeable development scenarios pertaining to lands within the Custer Gallatin National Forest. Specific scenarios in support of oil and gas leasing analysis on the Sioux and Beartooth Districts were developed in 2007 and 1993, respectively, for conventional oil and gas resources. BLM conducted reasonably foreseeable development scenarios, which typically consider both conventional oil and gas and coalbed methane occurrence and development potential have been conducted for lands encompassed within the current national forest planning area. These include the Montana Statewide Oil and Gas EIS and Amendment for the Powder River and Billings Resource Management Plans (USDI BLM 2003). This analysis was later amended via the 2008 Supplement to the Montana Statewide Oil and Gas EIS and Amendment of the Powder River and Billings Resource Management Plans (USDI 2008a). Subsequent to these planning efforts, a number of BLM Field Offices conducted resource management plans, which further reviewed reasonable foreseeable development scenarios.

The Butte Field Office 2009 Resource Management Plan covered a large portion of the Madison, Henrys Lake, Gallatin, Absaroka and Beartooth Mountains landscape area and the Bridger Bangtail portions of the Bridger, Bangtail and Crazy Mountain landscape area (USDI BLM 2009). Areas in the western portions of this area were identified as having low to very low leasable mineral occurrence and development potential due to the underlying igneous and metamorphic nature of the geologic environment. Additionally, the folding and faulting associated with this mountainous terrain does not favor formation of larger trap environments required to house leasable mineral resources.

The Bridger Bangtail portions of the Bridger, Bangtail and Crazy Mountain landscape area were found to have a moderate occurrence and development potential associated with known occurrences of coal and organic shale formations within this area, as well as a favorable structural environment for oil and gas resources (USDI BLM 2009 and 2010).

In 2010, the BLM Billings Field Office conducted a resource management plan planning effort that covered the "Beartooth Front" portions of the Madison, Henrys Lake, Gallatin, Absaroka and Beartooth Mountains landscape area and additionally covered the Crazy Mountains portion of the Bridger, Bangtail and Crazy Mountains landscape area (USDI BLM 2010). The plan also included consideration of the Pryor Mountains. Areas along the northern margin of the Beartooth Mountains were rated as having moderate occurrence and development oil and gas potential. All other portions of the Custer Gallatin

National Forest that were covered by the 2010 Billings Field Office reasonably foreseeable development scenario were rated as having low oil and gas mineral potential.

In 2015, the BLM's Miles City Field Office conducted a Resource Management Planning effort for lands it manages in response to Sage Grouse viability concerns. As a part of these analyses, a reasonably foreseeable development scenario for leasable mineral resources was conducted. The scenario covered all lands within the Field Office's jurisdiction as well as the lands occupied by the Ashland District. The Ashland District was identified as having moderate to high oil and gas occurrence and development potential (USDI BLM 2015a). Additionally, a 1989 reasonably foreseeable development scenario conducted for the Miles City-Tongue River Area, identified the Ashland District portion of their analysis area as having high leasable mineral resource occurrence potential, while the development potential was rated as high to moderate (USDI BLM 1989). Although there is a limited history and success related to exploration and development of conventional oil targets, the area is well known for the occurrence of gas resources associated with biogenic (coalbed methane) gas resources.

In 2015, the BLM Wyoming State Office Reservoir Management Group conducted a reasonably foreseeable development scenario for the lands managed by the South Dakota Field Office. This review included the Sioux District. The area is located within a geologic area known as the Sioux Arch province and is known to contain significant resources of oil and gas. The scenario found that the area has a high potential for the occurrence and development of oil and gas resources. However, the same evaluation found that lands within the Sioux District have a low occurrence and development potential related to coalbed methane resources (USDI BLM 2015b).

Generally, the western and central portions of the planning area consisting of the Madison, Henrys Lake, Gallatin, Absaroka and Beartooth Mountains and the Pryor Mountain landscape areas have a low to moderate occurrence potential related to the presence of oil and gas, coal, and coalbed methane. These areas, with the exception of the Pryor Mountains, are generally composed of igneous and metamorphic rocks. Within this larger area, site-specific geology may support the presence of coal and coalbed methane resources in isolated locations. These areas are not believed to house large economically significant occurrences of conventional oil and gas resources or coal and associated coalbed methane resources. Thus, the development potential for these landscape areas are rated as low.

Similarly, the Crazy Mountains and Bridger Bangtail landscape areas generally are rated as having a low to moderate occurrence and development potential as a result igneous and metamorphic processes which have taken place over time although the eastern portions of the Bangtails are rated as having a high occurrence potential. Known but isolated occurrences of coal and possible coal bed methane may be found in these areas, there are no known large-scale deposits of these leasable mineral resources. The areas are rated as low to moderate in terms of occurrence potential. The development potential for these areas are also rated as low due to their isolated and limited scale of these mineral deposits and in recognition of the fact that local and regional social and environmental concerns would likely serve as a deterrent to future development of these limited resources.

Lastly, the Ashland and Sioux District are rated as having a moderate to high occurrence potential for leasable mineral resources inclusive of conventional oil and gas as well as coal and coalbed methane. These areas are composed entirely of sedimentary rocks with known occurrences and production of oil, gas, coal and coalbed methane within or adjacent to these portions of the forest. However, given recent downturns in the oil and gas market, future development potential for the eastern districts of the Custer Gallatin National Forest is rated as moderate to low.

Mineral Materials

Infrastructure developments both on and off the Custer Gallatin National Forest will drive the demand/ and need for a variety of mineral material products including construction aggregate, drain rock, and rip rap as examples. Road maintenance, mineral development, landscape and abandoned mine restoration activities, and campground management actions are expected to occur within the national forest. Non-Federal interest such as County or State Governments or private commercial interest may also request development of Federal saleable minerals.

Over the last 10 years, the Custer portion of the national forest has typically issued 20 to 30 personnel use mineral material permits while the Gallatin portion has typically issued 80 to 100 personnel use mineral material permits. Most of these permits have been related to landscaping or petrified wood collection. Minor amounts of mineral materials have been used for the purposes of forest infrastructure maintenance and construction, while no commercial use permits have been issued during this timeframe. It is anticipated that this level of activity will continue or possibly increase over the lifespan of the revised forest plan.

Geologic Areas of Interest

Designated or Development Geologic Areas of Interest, Caves and Karst, and Paleontological Resources

Trends and drivers related to the management and conservation of these features is largely associated with increased use of national forest lands or increased development of lands and resources within or adjacent to the planning area.

Areas that had been designated as special interest areas will likely experience increasing visitation depending on overarching national economic conditions. The Forest Service’s ability to manage this increasing use will be governed by staffing and funding conditions over the planning horizon. It is not uncommon that unstaffed and undermanaged geologic features and facilities are often degraded or destroyed. Given the irreplaceable nature of most of these features, loss or reduction in the geologic and scientific integrity of the planning area could occur.

Visitation to caves is expected to increase as populations and use increase regionally and nationally, resulting in additional impacts to cave resources as previously discussed. Potential for karst aquifer contamination and cave resource damage due to land management activities is expected to increase without specific guidance and standards to mitigate potential for such contamination.

Similarly, increased visitation and exploration, especially if unauthorized by Federal authorities have the potential to significantly degrade the geologic and scientific value of paleontological resources found within the Custer Gallatin National Forest.

Geologic Hazards

Erionite/Offretite/Uranium

Trends and drivers related to human health and safety implications resulting from exposure to erionite, offretite, and uranium, are directly related to the amount and location of ground disturbances as well as the intensity and duration of the exposure. These minerals are naturally occurring elements within some lands located within the Custer Gallatin. However, land disturbances and management actions, such as surfacing project area roads with erionite bearing gravel, combined with increased use and occupation of these areas by members of the public may increase exposure potential.

Mass Wasting

Trends and drivers that will affect areas of current and possible future mass wasting (landslide) events are largely related to natural events such as earthquakes, wildfire, precipitation duration and intensity as well as potential human actions such as road construction and maintenance or facilities management.

Abandoned Mines and CERCLA Sites

Trends and drivers affecting the Custer Gallatin's ability to address abandoned mine and CERCLA sites will be determined by the ability to adequately staff and fund reclamation efforts and the likelihood that a particular site or constituent may threaten a release of materials to the environment and the public.

Existing Energy Transmission Corridors and Potential Need for New Transmission Corridors

The Energy Policy Act of 2005 set forth various provisions that directed the way certain Federal agencies, including the Forest Service, would authorize the use of land for a variety of energy-related purposes. Section 368 of Energy Policy Act requires the designation of energy corridors on Federal lands in 11 western states; the establishment of procedures to ensure that additional corridors are identified and designated as necessary and to expedite applications to construct or modify oil, gas, and hydrogen pipelines and electricity transmission and distribution facilities. A 2008 Programmatic Environmental Impact Statement (USDI BLM 2008a) was finalized that identified and designated energy corridors on western Federal Lands. As a result of this analysis and related decision, no corridors for location of future oil, gas, and hydrogen pipelines and/or electricity transmission and distribution facilities were identified within Federal lands managed by the Custer Gallatin National Forest.

The Custer Gallatin has received specific local energy transmission permit applications. One permit request was associated with providing increase electrical power to the Big Sky portion of the Bozeman District within the Gallatin River Canyon. The other permit request was associated with providing increase electrical power to the Stillwater Mining Company with an upgrade to the Chrome Junction facility located within the Beartooth District. Additional needs/desires for new transmission corridors within or crossing the Forest is unknown at this time. The landscape, land status, and mixed surface ownership within the western portions of the national forest and proximity to Yellowstone National Park, may not be conducive to location of energy transmission corridors. However, the eastern portions of the national forest do not have these same considerations and the area may be attractive for future transmission corridors.

Information Needs

Locatable Minerals

Development of known locatable mineral occurrences or locations involving current or past mineral activities within a GIS data layer would be helpful. This information could be used in development of and identification of future forest planning locatable mineral management emphasis areas. Most placer and hardrock locatable mineral deposits have been defined through historic exploration and mining activities or through assessments conducted by the U.S. Geological Survey or the Montana Bureau of Mines and Geology. Forest Service responsibility related to the management of locatable minerals is largely directed by existing law, regulation, and policy.

Leasable Minerals

Development of known leasable mineral occurrences or locations involving current or past leasable mineral activities within a GIS database layer would be helpful. This information could be used in development of and identification of future forest planning mineral management emphasis areas.

Resource management plans, including portrayal of a reasonably foreseeable development scenario, have been conducted by BLM State Offices and BLM field offices, which coincide with the forest planning assessment area. Areas with very low, low, moderate, and high leasable mineral occurrence and development potential have been defined through historic exploration and production activities or through reasonably foreseeable development scenario assessments. Forest Service responsibility related to the management of leasable minerals is largely directed by existing law, regulation, and policy. Prior to lease offer, most lands within the Custer Gallatin National Forest would require a leasing environmental impact statement in conformance with the *Conner v. Burford* court case. Only the South Dakota portion of the Sioux District and the Beartooth Mountain portion of the Beartooth District currently has an oil and gas leasing analysis in conformance with Forest Service regulations and *Conner v. Burford.* In the event that there is future demand for Federal leasable mineral resources, supporting data related to surface resources which may be affected by exploration, development, and production activities would be necessary.

Mineral Minerals

Information needs associated with the management of saleable mineral resources within the Custer Gallatin National Forest will be influenced by existing and future infrastructure construction and maintenance needs. Knowledge of possible Federal and private demand for these resources would be helpful. Development of known mineral material occurrences or locations involving current or past mineral activities within a GIS database layer would be helpful. This information could be used in development of and identification of future forest planning mineral management emphasis areas.

Geologic Areas of Interest

Designated or Developed Geologic Areas of Interest

Information needs such as volume and season of public use and the amount of degradation to designate or developed geologic areas of interest would be useful.

Cave and Karst Areas

A formal cave inventory has not been completed for most portions of the Custer Gallatin National Forest other than the Pryor Mountains and that inventory is ongoing. Future information needs include initiation of cave resource investigations in other land units within the national forest. Additionally, the development and maintenance of a national forestwide cave inventory should be continued and augmented. This includes processing pending Federal Cave Resources Protection Act cave significance determinations for the Beartooth Ranger District and evaluating known caves on the Bozeman, Gardiner, and Yellowstone Districts for Federal Cave Resources Protection Act significance. Developing a GIS layer of potential and known karst/cave areas would also be helpful. Further, a spatial analysis of potential implications to municipal watersheds, public water supplies, livestock spring developments, fish-bearing streams, and groundwater wells should be considered.

Paleontology

Additional information related to paleontological resource occurrence and use, whether authorized or otherwise is desirable. The Custer Gallatin National Forest contains extensive exposures of geologic formations known to contain important fossil resources. The amount of unauthorized collection of these resources is currently not known. An increased field knowledge and presence by Forest Service personnel would be required to address these informational needs.

Geologic Hazards

Erionite/Offretite/Uranium

An increased knowledge in regards to possible human health and safety implications resulting from exposure to erionite, offretite, and uranium is very desirable. Information relevant to Forest Service employees, permittees and national forest visitors may be useful in determining the location and type of management actions which can be safely undertaken.

Mass Wasting

Gathering of information related to location and movement of known or developing mass wasting features that might impact current or future national forest infrastructure could potentially minimize impacts to capital investments and forest users.

Abandoned Mines and CERCLA Sites

Additional information and data is needed related to abandoned mines and CERCLA sites including identification and evaluation of additional abandoned mine features, the geographic extent of constituent contamination, and severity of possible effects to biologic and abiotic systems Additionally, information related to the amount of human occupation and use of these area is desirable.

Key Findings

Overall Renewable and Nonrenewable Energy and Mineral Forest Plan Program Direction

Generally, management guidance provided in both the original Custer and Gallatin forest plans were sufficient to prevent, preclude, or eliminate large scale unacceptable resource effects while providing opportunities for renewable and nonrenewable energy and mineral resource production. However, these first generation forest plans lack management direction related to important geological or mineral considerations, such as geologic hazards and geologic resources. Some of the management direction or designations within the respective forest plans are conflictive. As previously indicated, mitigations and resource protections that are included with these approved plans include requirements addressing water quality, water quality, wildlife and fisheries, cultural resources, reclamation practices and social or forest user implications. Assignment and approval of these environmental and social mitigations are in conformance with both the current Custer and Gallatin forest plans. To date, these prescribed and implemented mitigation have largely precluded violation of Federal or State statues pertaining to these resource values.

Locatable Minerals

Locatable mineral activities that take place on the Custer Gallatin National Forest contribute significant economic, social, and recreational benefits to local and regional interest. The Stillwater Complex likely houses sufficient platinum and palladium resources necessary to support mining of these minerals for the next 30 to 50 years.

Hobbyist level placer operations are likely to continue in areas of known mineral occurrences. Management of these types of actions may increasingly offer a challenge to the Custer Gallatin given their widespread occurrence and the limited ability of mineral management personnel to address these needs in addition to larger scale mineral development actions.

Leasable Minerals

Oil and gas leasing analyses are largely absent for the majority of lands contained within the Custer Gallatin National Forest. Only the South Dakota portion of the Sioux District and the Beartooth Mountain portion of the Beartooth District have had a recent oil and gas leasing environmental impact statement conducted. The eastern portions of the planning area likely houses significant amounts of leasable mineral resources. Subsequent oil and gas leasing environmental impact statements would be required in order to make other lands within the forest available for future leasable mineral activities.

Mineral Materials

Utilization and demand for mineral materials will likely increase over the life of the forest plan. This increased demand will be related to construction and maintenance of infrastructure located within and adjacent to the Custer Gallatin National Forest. Currently, not all ranger districts within the Custer Gallatin have active mineral material locations or an inventory of possible mineral material development locations. A revised forest plan should provide forestwide and site-specific considerations related to identification and use of potential mineral material resources.

Areas of Geologic Interest

Designated and Developed Areas of Geologic Interest

Areas of geologic interest are highly valued by national forest visitors and represent irreplaceable natural features within the Custer Gallatin landscape. As use of the national forest increases, it is anticipated that the use of these areas will also increase. The agency’s ability to manage and conserve the geologic and scientific integrity of these features will largely be influenced by availability of staff and funding.

Cave and Karst

There is an overall lack of information regarding the extent, type, and features of Custer Gallatin cave and karst resources. Several known caves have not been evaluated for significance determinations under the Federal Cave Resources Protection Act. Custer National Forest Plan Amendment 8 provides management guidance pertaining to cave and karst geologic resources for the Sioux, Ashland and Beartooth Districts. Cave and karst geologic resources are managed under Federal Cave Resources Protection Act for the remaining portions of the Custer Gallatin. Forest Plan level standards, guidelines, and other management direction is lacking with regards to protection of cave and karst resources and compliance with applicable law, regulation, and policy, including the Federal Cave Resources Protection Act.

Paleontology

Additional investigations related to paleontological resource occurrence are desirable. The Custer Gallatin contains exposures of geologic formations known to contain important fossil resources. The amount of unauthorized collection of these resources is currently not known. An increased field knowledge and presence by Forest Service personnel would be required to address these informational needs. There is an overall lack of paleontology management guidelines and standards in the current forest plans. Standards, guidelines, and practices are needed to ensure protection of paleontology resources and compliance with applicable law, regulation, and policy. Information related to locations of anticipated surface disturbance activities within the bounds of the national forest would be helpful in assessing potential effects to paleontological resources that may be directly affected by the action.

Geologic Hazards

There is an overall lack of management guidelines and standards in the current forest plans pertaining to geologic hazards. Standards, guidelines, and practices are needed to ensure human health and safety concerns are addressed in compliance with applicable law, regulation, and policy.

Erionite/Offretite/Uranium

Geologic formations found primarily in the far eastern extent of the Custer Gallatin National Forest contain naturally occurring minerals which potentially represents health and safety concerns to humans. Similarly, the central portion of the planning area also contains naturally occurring minerals such as asbestos and erionite. Although investigations of health and safety implications to Forest Service employees for certain specific national forest management tasks conducted on the Sioux District have been undertaken, health and safety implications to these workers is incomplete. The National Institute for Occupational Safety and Health recently issued hazard exposure mitigation recommendations in 2013 related to conducting forest management actions within areas known or suspected of containing erionite/offretite. Future ground disturbing management actions should consider not only the 2013 recommendations but also current scientific information prior to conducting ground-disturbing actions, and implications to public use and visitation.

Mass Wasting

Areas of existing known and potential mass wasting occur within the planning area. These features are naturally occurring and often related to recent extreme fire activities and precipitation events. Monitoring of these features should be considered in areas where they may potentially affect national forest developments, private investments, or areas which experience a high degree of recreational use.

Abandoned Mine and CERCLA Sites

The Custer Gallatin National Forest contains numerous abandoned mine sites. These areas are distributed across each forest landscape area. CERCLA or potential CERCLA sites are located mostly within the Sioux District, although the New World Mine CERCLA site is found within the Madison, Henrys Lake, Gallatin, Absaroka and Beartooth Mountains landscape area. Future CERCLA actions will focus on the areas associated with the Riley Pass CERCLA site and possibly the Lonesome Pete Abandoned Uranium Mine Site. Site restoration efforts with the Forest Service's Mine Safety Program will continue to address both uranium exploration disturbances but also more complex abandoned hardrock exploration and mining features mostly located in the western portions of the planning area. The Custer Gallatin's ability to identify, plan, and implement these restoration efforts will be influenced by the availability of funds and staff necessary to implement these complex closures in isolated locations.

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